Message

From: Whitlock, Steve [Whitlock.Steve@epa.gov]
Sent: 1/17/2018 3:13:41 PM
To: Kim Wagoner [Kim.Wagoner@erg.com]; Flanders, Phillip [Flanders.Phillip@epa.gov]; Born, Tom [Born.Tom@epa.gov]; Deborah Bartram [deborah.bartram@erg.com]; Elizabeth Gentile [elizabeth.gentile@erg.com]; Kimberly Bartell [Kimberly.Bartell@erg.com]; Cuff, Jalyse [cuff.jalyse@epa.gov]
Subject: RE: 304m weekly calls

I'll be joining the call late today.
--Steve--

From: Kim Wagoner [mailto:Kim.Wagoner@erg.com]
Sent: Wednesday, January 17, 2018 10:10 AM
To: Flanders, Phillip <Flanders.Phillip@epa.gov>; Whitlock, Steve <Whitlock.Steve@epa.gov>; Born, Tom <Born.Tom@epa.gov>; Deborah Bartram <deborah.bartram@erg.com>; Elizabeth Gentile <elizabeth.gentile@erg.com>; Kimberly Bartell <Kimberly.Bartell@erg.com>; Cuff, Jalyse <cuff.jalyse@epa.gov>
Subject: RE: 304m weekly calls

Good morning! Attached is the updated punch list. In addition for the agenda we have:

- Final 2016 Plan and Review Report
  - Deliberative Process / Ex. 5
- Preliminary 2018 Plan and Review Report
  - Deliberative Process / Ex. 5
- Pilot technology review
- IWTT
  - Deliberative Process / Ex. 5
- EJ
- HELGA
- Kick-off meetings/calls – ERG delivered draft agendas on 11/20
  - Deliberative Process / Ex. 5
- Deliberative Process / Ex. 5

Anything else?

Kim Wagoner, P.E.
Environmental Engineer
ERG
14555 Avion Parkway Suite 200

Chantilly, VA 20151
703-633-1620

-----Original Appointment-----
From: Kim Wagoner
Sent: Wednesday, May 17, 2017 12:44 PM
To: Kim Wagoner; Flanders, Phillip; Whitlock.steve@Epa.gov; Born, Tom; Deborah Bartram; Elizabeth Gentile; Kimberly Bartell; cuff.jalyse@epa.gov
Subject: 304m weekly calls
When: Wednesday, January 17, 2018 11:00 AM-12:00 PM (UTC-05:00) Eastern Time (US & Canada).
Where: Via conference call: [redacted]

All, we have to make a change to our call-in information for our weekly calls. Please note the new number below.

Call In [redacted]
Code:

Message

From: Kim Wagoner [Kim.Wagoner@erg.com]
Sent: 1/17/2018 3:10:10 PM
To: Flanders, Phillip [Flanders.Phillip@epa.gov]; Whitlock, Steve [Whitlock.Steve@epa.gov]; Born, Tom [Born.Tom@epa.gov]; Deborah Bartram [deborah.bartram@erg.com]; Elizabeth Gentile [elizabeth.gentile@erg.com]; Kimberly Bartell [Kimberly.Bartell@erg.com]; Cuff, Jalyse [cuff.jalyse@epa.gov]
Subject: RE: 304m weekly calls
Attachments: Punch List Final 2016 Plan 011718.xlsx

Good morning! Attached is the updated punch list. In addition for the agenda we have:

- Final 2016 Plan and Review Report
  - Deliberative Process / Ex. 5
- Preliminary 2018 Plan and Review Report
  - Deliberative Process / Ex. 5
- Pilot technology review
- IWTT
  - Deliberative Process / Ex. 5
- EJ
- HELGA
- Kick-off meetings/calls – ERG delivered draft agendas on 11/20
  - Deliberative Process / Ex. 5
- Deliberative Process / Ex. 5

Anything else?

Kim Wagoner, P.E.
Environmental Engineer
ERG
14555 Avion Parkway Suite 200
Chantilly, VA 20151
703-633-1620

-----Original Appointment-----
From: Kim Wagoner
Sent: Wednesday, May 17, 2017 12:44 PM
To: Kim Wagoner; Flanders, Phillip; Whitlock.steve@Epa.gov; Born, Tom; Deborah Bartram; Elizabeth Gentile; Kimberly Bartell; cuff.jalyse@epa.gov
Subject: 304m weekly calls

When: Wednesday, January 17, 2018 11:00 AM-12:00 PM (UTC-05:00) Eastern Time (US & Canada).
Where: Via conference call: [redacted]

All, we have to make a change to our call-in information for our weekly calls. Please note the new number below.

Call In[redacted]
Code:

Message

From: Kimberly Bartell [Kimberly.Bartell@erg.com]
Sent: 3/21/2018 2:27:13 PM
To: Flanders, Phillip [Flanders.Phillip@epa.gov]; Whitlock, Steve [Whitlock.Steve@epa.gov]; Born, Tom [Born.Tom@epa.gov]; Tripp, Anthony [Tripp.Anthony@epa.gov]
CC: Elizabeth Gentile [elizabeth.gentile@erg.com]; Deborah Bartram [deborah.bartram@erg.com]; Kim Wagoner [Kim.Wagoner@erg.com]
Subject: 304m Weekly Call Agenda 3/21
Attachments: Punch List Final 2016 Plan 032118.xlsx

Good morning! Attached is the updated punch list. In addition for the agenda we have:

- Final 2016 Plan and Review Report
    - Deliberative Process / Ex. 5
- Preliminary 2018 Plan and Review Report
    - Deliberative Process / Ex. 5
- IWTT
    - Deliberative Process / Ex. 5
- EJ
- HELGA
    - Deliberative Process / Ex. 5
- Generic ICR
    - Deliberative Process / Ex. 5
- EGIS
    - Deliberative Process / Ex. 5
- Cost tool/Pilot technology review
    - Deliberative Process / Ex. 5
- E&EC Study
- 303d Data Request: delivered 3/15/18

Anything else?

Message

From: Kim Wagoner [Kim.Wagoner@erg.com]
Sent: 8/22/2018 12:56:39 PM
To: Flanders, Phillip [Flanders.Phillip@epa.gov]; Whitlock, Steve [Whitlock.Steve@epa.gov]; Born, Tom [Born.Tom@epa.gov]; Deborah Bartram [deborah.bartram@erg.com]; Elizabeth Gentile [elizabeth.gentile@erg.com]; Tripp, Anthony [Tripp.Anthony@epa.gov]; Molly McEvoy [Molly.McEvoy@erg.com]
Subject: RE: 304m weekly calls
Attachments: Prelim 2018 Plan Outline_052918_V2.docx; ELG Planning Punch List_082218.xlsx

Good morning! Attached is the updated punch list. In addition for the agenda we have:

Deliberative Process / Ex. 5

Anything else?

Kimberly Wagoner, P.E.
Sr. Environmental Engineer
ERG

14555 Avion Parkway, Suite 200
Chantilly, VA 20151
(O) 703-633-1620
(C) 703-328-3392

-----Original Appointment-----
From: Kim Wagoner
Sent: Wednesday, May 17, 2017 12:44 PM
To: Kim Wagoner; Flanders, Phillip; Whitlock.steve@Epa.gov; Born, Tom; Deborah Bartram; Elizabeth Gentile; Tripp, Anthony; Molly McEvoy
Subject: 304m weekly calls
When: Wednesday, August 22, 2018 11:00 AM-12:00 PM (UTC-05:00) Eastern Time (US & Canada).
Where: Via conference call: [redacted]

All, we have to make a change to our call-in information for our weekly calls. Please note the new number below.

Call In [redacted]
Code:

Appointment

From: Penman, Crystal [Penman.Crystal@epa.gov]
Sent: 8/22/2018 1:30:02 PM
To: Forsgren, Lee [Forsgren.Lee@epa.gov]; Best-Wong, Benita [Best-Wong.Benita@epa.gov]; McDonough, Owen [mcdonough.owen@epa.gov]; Wildeman, Anna [wildeman.anna@epa.gov]
CC: Penman, Crystal [Penman.Crystal@epa.gov]; Campbell, Ann [Campbell.Ann@epa.gov]; Nagle, Deborah [Nagle.Deborah@epa.gov]; Wood, Robert [Wood.Robert@epa.gov]; Damico, Brian [Damico.Brian@epa.gov]; Flanders, Phillip [Flanders.Phillip@epa.gov]; Parikh, Pooja [Parikh.Pooja@epa.gov]; Crawford, Tiffany [Crawford.Tiffany@epa.gov]; Levine, MaryEllen [levine.maryellen@epa.gov]; Neugeboren, Steven [Neugeboren.Steven@epa.gov]

Subject: Preliminary ELG Program Plan 14: Options Selection
Attachments: Flanders--Meeting Request OW Leadership2018-08-02-152054.pdf; PrelimPlan14 Briefing_082118.docx
Location: 3233 WJCE Call in[redacted]

Start: 8/22/2018 6:00:00 PM
End: 8/22/2018 6:45:00 PM
Show Time As: Tentative

Message

From: Kim Wagoner [Kim.Wagoner@erg.com]
Sent: 11/28/2018 3:28:14 PM
To: Flanders, Phillip [Flanders.Phillip@epa.gov]; Whitlock, Steve [Whitlock.Steve@epa.gov]; Born, Tom [Born.Tom@epa.gov]; Deborah Bartram [deborah.bartram@erg.com]; Elizabeth Gentile [elizabeth.gentile@erg.com]; Tripp, Anthony [Tripp.Anthony@epa.gov]; Molly McEvoy [Molly.McEvoy@erg.com]
Subject: RE: 304m weekly calls
Attachments: ELG Planning Punch List_112818.xlsx; Budget Tracking _for EPA Discussion_112718.xlsx

Good morning! Attached is the updated punch list. In addition for the agenda we have:

Deliberative Process / Ex. 5

- Record disposition update

Anything else?

Kimberly Wagoner, P.E.
Sr. Environmental Engineer
ERG
14555 Avion Parkway, Suite 200
Chantilly, VA 20151
(O) 703-633-1620
(C) 703-328-3392

-----Original Appointment-----
From: Kim Wagoner
Sent: Wednesday, May 17, 2017 12:44 PM
To: Kim Wagoner; Flanders, Phillip; Whitlock.steve@Epa.gov; Born, Tom; Deborah Bartram; Elizabeth Gentile; Tripp, Anthony; Molly McEvoy
Subject: 304m weekly calls
When: Wednesday, November 28, 2018 11:00 AM-12:00 PM (UTC-05:00) Eastern Time (US & Canada).
Where: Via conference call: [redacted]

All, we have to make a change to our call-in information for our weekly calls. Please note the new number below.

Call In [redacted]
Code: [redacted]

Message

From: Kim Wagoner [Kim.Wagoner@erg.com]
Sent: 2/27/2019 2:28:09 PM
To: Flanders, Phillip [Flanders.Phillip@epa.gov]; Whitlock, Steve [Whitlock.Steve@epa.gov]; Born, Tom [Born.Tom@epa.gov]; Deborah Bartram [deborah.bartram@erg.com]; Elizabeth Gentile [elizabeth.gentile@erg.com]; Molly McEvoy [Molly.McEvoy@erg.com]
Subject: RE: 304m weekly calls
Attachments: ELG Planning Punch List_022719.xlsx; Budget Tracking _for EPA_2019.02.27.xlsx

Good morning! Attached is the updated punch list. In addition for the agenda we have:

- Preliminary Plan 14
  - ERG formatted plan, any additional support?
  - Need to update references with DCNs and log references into the record
- PFAS
  - Deliberative Process / Ex. 5
- Nutrients
  - Deliberative Process / Ex. 5
- IWTT
  - Deliberative Process / Ex. 5
- ELG Database
  - Deliberative Process / Ex. 5
- Generic ICR/EGIS
  - Deliberative Process / Ex. 5
- Cost tool/technology review
- EJScreen – POTW removals
- Environmental issues analysis
  - Deliberative Process / Ex. 5
- PSC Noncompliance Review
  - Deliberative Process / Ex. 5
- Oil and Gas study record items - complete
- Budget – see attached spreadsheet

Anything else?

Kimberly Wagoner, P.E.
Sr. Environmental Engineer
ERG

14555 Avion Parkway, Suite 200
Chantilly, VA 20151
(O) 703-633-1620
(C) 703-328-3392

-----Original Appointment-----
From: Kim Wagoner
Sent: Wednesday, May 17, 2017 12:44 PM
To: Kim Wagoner; Flanders, Phillip; Whitlock.steve@Epa.gov; Born, Tom; Deborah Bartram; Elizabeth Gentile; Tripp, Anthony; Molly McEvoy
Subject: 304m weekly calls
When: Wednesday, February 27, 2019 11:00 AM-12:00 PM (UTC-05:00) Eastern Time (US & Canada).
Where: Via conference call: [redacted]

All, we have to make a change to our call-in information for our weekly calls. Please note the new number below.

Call In[redacted]
Code:[redacted]

Message

From: Molly McEvoy [Molly.McEvoy@erg.com]
Sent: 11/22/2018 12:27:01 AM
To: Flanders, Phillip [Flanders.Phillip@epa.gov]
CC: Kim Wagoner [Kim.Wagoner@erg.com]; Whitlock, Steve [Whitlock.Steve@epa.gov]
Subject: RE: Please clean this version of the plan
Attachments: Draft Prelim Plan 14_2018.11.21.docx

Hi Phillip,

Attached, please find the revised draft of the plan. We formatted the new tables, reformatted the pie charts and made pie chart colors consistent for each industry, added URLs in footnotes, and formatted new in-text citations. We noted two places where we will need to make static versions of references for the record in the nutrients section. Would it be possible for Steve to confirm we cited the correct data/documents in the first paragraph of Section 3.1? We also responded to a couple of your comments and removed those addressed to ERG. Per our discussion today, we did not make any changes in Sections 3.7 and 3.8 except for table formatting. Please let us know if you would like any further revisions.

Thanks and have a happy Thanksgiving!

Molly

From: Flanders, Phillip <Flanders.Phillip@epa.gov>
Sent: Monday, November 19, 2018 11:32 AM
To: Kim Wagoner <Kim.Wagoner@erg.com>
Cc: Molly McEvoy <Molly.McEvoy@erg.com>
Subject: Re: Please clean this version of the plan

Wednesday is fine. I am expecting that we will have more changes from senior management so it is not final yet - no need for editing support.

From: Kim Wagoner <Kim.Wagoner@erg.com>
Sent: Monday, November 19, 2018 10:52:33 AM
To: Flanders, Phillip
Cc: Molly McEvoy
Subject: RE: Please clean this version of the plan

Phillip, I just realized I may have been confused by the due dates in your email. It may take us a little bit of time to fix the nutrient graphs and we have one minor question for you regarding the URL references that we were hoping to touch base with you on during our call on Wednesday. We should be able to have the plan cleaned up and formatted shortly after our call this week if that works. I also wanted to confirm that you won't need editing support on this version? It seems like you are anticipating additional changes, so we can wait to complete that step at the very end. Just let us know.

Kimberly Wagoner, P.E.
Sr. Environmental Engineer
ERG
14555 Avion Parkway, Suite 200
Chantilly, VA 20151
(O) 703-633-1620
(C) 703-328-3392

From: Kim Wagoner
Sent: Monday, November 19, 2018 8:31 AM
To: 'Flanders, Phillip' <Flanders.Phillip@epa.gov>
Subject: RE: Please clean this version of the plan

Sorry for the delay Phillip, I was out at the end of last week but Molly and our team were working on it last week and we should be able to get this back to you today.

Kimberly Wagoner, P.E.
Sr. Environmental Engineer
ERG
14555 Avion Parkway, Suite 200
Chantilly, VA 20151
(O) 703-633-1620
(C) 703-328-3392

From: Flanders, Phillip <Flanders.Phillip@epa.gov>
Sent: Thursday, November 15, 2018 3:57 PM
To: Kim Wagoner <Kim.Wagoner@erg.com>
Subject: Please clean this version of the plan

Kim,

Can ERG spend the next couple of days cleaning up this version of the plan? I'm sure they'll be more text edits, but there are some formatting things I'd like ERG to address before seeking higher level management review. Please leave comments not addressed to ERG in the document. You'll notice that I intentionally removed the acronym PSC (point source category), Jessica (OGC) thought that was needlessly creating a new acronym in a document that already has lots of acronyms. She couldn't remember having seen it in plans before. She also wanted us to not use ESA for "economic screening analysis" because that is confusing given the more agency-standard meaning of "endangered species act." I attempted to remove that acronym as well. (It should only have existed in that one section.) If you notice any more please go ahead and fix them.

No need to propogate removing "PSC" to any other document (e.g. the full length nutrients report) – it's just to help keep this document more readable. I think this is part of the advantage of having the supporting documents stand alone – we won't have to go back and fix all of this.

If you have to staffing to finish this by Wednesday (11/21) that would be great, otherwise COB Monday (11/19) would also be okay.

Thank you,

Phillip Flanders, Ph.D., P.E.

Environmental Engineer
Engineering and Analysis Division
Office of Science and Technology
Office of Water

EPA United States Environmental Protection Agency

Mail Code 4303T

(202) 566-8323
www.epa.gov/eg

Message

From: Kim Wagoner [Kim.Wagoner@erg.com]
Sent: 11/21/2018 2:58:44 PM
To: Deborah Bartram [deborah.bartram@erg.com]; Flanders, Phillip [Flanders.Phillip@epa.gov]; Whitlock, Steve [Whitlock.Steve@epa.gov]; Born, Tom [Born.Tom@epa.gov]; Elizabeth Gentile [elizabeth.gentile@erg.com]; Tripp, Anthony [Tripp.Anthony@epa.gov]; Molly McEvoy [Molly.McEvoy@erg.com]
Subject: RE: 304m weekly calls
Attachments: ELG Planning Punch List_112118.xlsx

Good morning! Attached is the updated punch list. In addition for the agenda we have:

- Preliminary Plan 14
    - Deliberative Process / Ex. 5
- PFAS
    - Deliberative Process / Ex. 5
- Nutrients
    - Deliberative Process / Ex. 5
- IWTT
    - Deliberative Process / Ex. 5
- ELG Database
    - Deliberative Process / Ex. 5
- Generic ICR
    - Deliberative Process / Ex. 5
- EGIS
    - Deliberative Process / Ex. 5
- Cost tool/technology review
    - Deliberative Process / Ex. 5
- EJScreen
    - Deliberative Process / Ex. 5
- Environmental issues analysis – ERG delivered summary of internal brainstorm on 9/25
- PSC Noncompliance Review
- WEFTEC 2019 call for abstracts
- Budget – approved ceiling

Anything else?

Kimberly Wagoner, P.E.
Sr. Environmental Engineer
ERG
14555 Avion Parkway, Suite 200
Chantilly, VA 20151
(O) 703-633-1620
(C) 703-328-3392

-----Original Appointment-----
From: Kim Wagoner
Sent: Wednesday, May 17, 2017 12:44 PM
To: Deborah Bartram; Kim Wagoner; Flanders, Phillip; Whitlock.steve@Epa.gov; Born, Tom; Elizabeth Gentile; Tripp, Anthony; Molly McEvoy
Subject: 304m weekly calls
When: Wednesday, November 21, 2018 11:00 AM-12:00 PM (UTC-05:00) Eastern Time (US & Canada).
Where: Via conference call: [redacted]

All, we have to make a change to our call-in information for our weekly calls. Please note the new number below.

Call In [redacted]
Code:

Appointment

From: Penman, Crystal [Penman.Crystal@epa.gov]
Sent: 1/16/2018 2:58:58 PM
To: Campbell, Ann [Campbell.Ann@epa.gov]; Lape, Jeff [lape.jeff@epa.gov]; Wood, Robert [Wood.Robert@epa.gov]; Matuszko, Jan [Matuszko.Jan@epa.gov]; Flanders, Phillip [Flanders.Phillip@epa.gov]; Levine, MaryEllen [levine.maryellen@epa.gov]; Zomer, Jessica [Zomer.Jessica@epa.gov]
CC: Best-Wong, Benita [Best-Wong.Benita@epa.gov]; Forsgren, Lee [Forsgren.Lee@epa.gov]; Scozzafava, MichaelE [Scozzafava.MichaelE@epa.gov]; Neugeboren, Steven [Neugeboren.Steven@epa.gov]; Parikh, Pooja [Parikh.Pooja@epa.gov]

Subject: 2016 ELG Program Plan Prebrief
Attachments: Legal Framework for ELGPlan.docx; ELGplanbriefingross11218final v2.pptx
Location: 3233 WJCE

Start: 1/16/2018 3:00:00 PM
End: 1/16/2018 4:00:00 PM
Show Time As: Tentative

Message

From: Teresa Medley [Teresa.Medley@erg.com]
Sent: 3/16/2018 5:32:20 PM
To: Flanders, Phillip [Flanders.Phillip@epa.gov]
CC: Kim Wagoner [Kim.Wagoner@erg.com]; Tripp, Anthony [Tripp.Anthony@epa.gov]
Subject: OWEAD TPR/Invoice for Contract EP-C-17-041 - Pd 02/2018 (WA 0-05) - February 2018
Attachments: Invoice 05_2018 February WA 0-05.pdf; TPR 05_2018 February WA 0-05.pdf

ATTENTION: Information contained in this report is ERG privileged and confidential. The contents of this report shall not be duplicated, used, or disclosed in whole or in part without the permission of Eastern Research Group, Inc.

Please find attached the Technical Progress Report (TPR) and invoice for period of February 2018.

If you have any issues regarding the electronic formatting of this report.

Regards,

Teresa A. Medley, Project Assistant
Eastern Research Group, Inc.
14555 Avion Parkway, Ste, 200
Chantilly, VA 20151-1102
Phone: (703) 633-1655
Fax: (703) 263-7281
teresa.medley@erg.com

Message

From: Damico, Brian [Damico.Brian@epa.gov]
Sent: 1/12/2018 6:05:08 PM
To: Wood, Robert [Wood.Robert@epa.gov]; Scozzafava, MichaelE [Scozzafava.MichaelE@epa.gov]; Campbell, Ann [Campbell.Ann@epa.gov]; Flanders, Phillip [Flanders.Phillip@epa.gov]
Subject: FW: ELG Plan Briefing
Attachments: Legal Framework for ELGPlan.docx; ELGplanbriefingross11218final v2.PPTX

Good afternoon all,

Attached is the revised slide deck, as well as the unchanged Legal Framework document for your convenience.

Ann, I will be running 4 hard copies of each of these documents to you shortly.

-B

Brian D'Amico
Chief, Technology and Analytical Support Branch
Engineering and Analysis Division
Office of Science and Technology
U.S. Environmental Protection Agency
Washington, DC
(202) 566-1069 (Office)
(202) 384-2190 (EPA Cell)

From: Matuszko, Jan
Sent: Friday, January 12, 2018 12:58 PM
To: Damico, Brian <Damico.Brian@epa.gov>
Subject: Fw: ELG Plan Briefing

From: Matuszko, Jan
Sent: Friday, January 12, 2018 12:53 PM
To: Campbell, Ann
Cc: Wood, Robert; Scozzafava, MichaelE; Flanders, Phillip
Subject: ELG Plan Briefing

Here you go. Trying to make your 1pm deadline. Do you need someone to bring you hard copies as well.

Message

From: Matuszko, Jan [Matuszko.Jan@epa.gov]
Sent: 1/12/2018 5:53:09 PM
To: Campbell, Ann [Campbell.Ann@epa.gov]
CC: Wood, Robert [Wood.Robert@epa.gov]; Scozzafava, MichaelE [Scozzafava.MichaelE@epa.gov]; Flanders, Phillip [Flanders.Phillip@epa.gov]
Subject: ELG Plan Briefing
Attachments: ELGplanbriefingross11218final.PPTX; Legal Framework for ELGPlan.docx

Here you go. Trying to make your 1pm deadline. Do you need someone to bring you hard copies as well.

Message

From: Kim Wagoner [Kim.Wagoner@erg.com]
Sent: 3/14/2018 1:10:46 PM
To: Deborah Bartram [deborah.bartram@erg.com]; Flanders, Phillip [Flanders.Phillip@epa.gov]; Whitlock, Steve [Whitlock.Steve@epa.gov]; Born, Tom [Born.Tom@epa.gov]; Elizabeth Gentile [elizabeth.gentile@erg.com]; Kimberly Bartell [Kimberly.Bartell@erg.com]; Tripp, Anthony [Tripp.Anthony@epa.gov]
Subject: RE: 304m weekly calls
Attachments: Punch List Final 2016 Plan 031418.xlsx; Budget Review_031418.xlsx

Good morning! Attached is the updated punch list. In addition for the agenda we have:

- Final 2016 Plan and Review Report
  - Deliberative Process / Ex. 5
- Preliminary 2018 Plan and Review Report
  - Deliberative Process / Ex. 5
- IWTT
  - Deliberative Process / Ex. 5
- EJ
- HELGA
  - Deliberative Process / Ex. 5
- Generic ICR
  - Deliberative Process / Ex. 5
- EGIS
  - Deliberative Process / Ex. 5
- Cost tool/Pilot technology review
  - Deliberative Process / Ex. 5
- E&EC Study
- Updated budget (see attached spreadsheet)

Anything else?

Kim Wagoner, P.E.
Environmental Engineer
ERG
14555 Avion Parkway Suite 200
Chantilly, VA 20151
703-633-1620

-----Original Appointment-----
From: Kim Wagoner
Sent: Wednesday, May 17, 2017 12:44 PM
To: Kim Wagoner; Deborah Bartram; Flanders, Phillip; Whitlock.steve@Epa.gov; Born, Tom; Elizabeth Gentile; Kimberly Bartell; cuff.jalyse@epa.gov; Tripp, Anthony
Subject: 304m weekly calls
When: Wednesday, March 14, 2018 11:00 AM-12:00 PM (UTC-05:00) Eastern Time (US & Canada).
Where: Via conference call: [redacted]

All, we have to make a change to our call-in information for our weekly calls. Please note the new number below.

Call In [redacted]
Code:

Message

From: Damico, Brian [Damico.Brian@epa.gov]
Sent: 2/21/2019 7:31:28 PM
To: Wood, Robert [Wood.Robert@epa.gov]
CC: Born, Tom [Born.Tom@epa.gov]; Flanders, Phillip [Flanders.Phillip@epa.gov]
Subject: Revised ELG Plan Doc
Attachments: Draft Prelim Plan 14 20190221.docx

Rob,

Attached is the revised ELG Plan Document. Thanks to Phillip and Tom for pulling these changes together so quickly!!!!

-B

Brian D'Amico
Chief, Technology and Analytical Support Branch
Engineering and Analysis Division
Office of Science and Technology
U.S. Environmental Protection Agency
Washington, DC
(202) 566-1069 (Office)
(202) 384-2190 (EPA Cell)

Message

From: Kim Wagoner [Kim.Wagoner@erg.com]
Sent: 3/7/2018 2:50:07 PM
To: Flanders, Phillip [Flanders.Phillip@epa.gov]; Whitlock, Steve [Whitlock.Steve@epa.gov]; Born, Tom [Born.Tom@epa.gov]; Deborah Bartram [deborah.bartram@erg.com]; Elizabeth Gentile [elizabeth.gentile@erg.com]; Kimberly Bartell [Kimberly.Bartell@erg.com]; Tripp, Anthony [Tripp.Anthony@epa.gov]
Subject: RE: 304m weekly calls
Attachments: Punch List Final 2016 Plan 030718.xlsx

Good morning! Attached is the updated punch list. In addition for the agenda we have:

- Final 2016 Plan and Review Report
  - Deliberative Process / Ex. 5
- Preliminary 2018 Plan and Review Report
  - Deliberative Process / Ex. 5
- Pilot technology review – ERG drafting methodology; working to coordinate with cost tool
- IWTT
  - Deliberative Process / Ex. 5
- EJ
- HELGA
  - Deliberative Process / Ex. 5
- Generic ICR
  - Deliberative Process / Ex. 5
- EGIS
  - Deliberative Process / Ex. 5
- Cost tool
  - Deliberative Process / Ex. 5
- E&EC Study
- Deliberative Process / Ex. 5

Kim Wagoner, P.E.
Environmental Engineer
ERG
14555 Avion Parkway Suite 200
Chantilly, VA 20151
703-633-1620

-----Original Appointment-----
From: Kim Wagoner
Sent: Wednesday, May 17, 2017 12:44 PM
To: Kim Wagoner; Flanders, Phillip; Whitlock.steve@Epa.gov; Born, Tom; Deborah Bartram; Elizabeth Gentile; Kimberly Bartell; cuff.jalyse@epa.gov; Tripp, Anthony
Subject: 304m weekly calls
When: Wednesday, March 7, 2018 11:00 AM-12:00 PM (UTC-05:00) Eastern Time (US & Canada).
Where: Via conference call: [redacted]

All, we have to make a change to our call-in information for our weekly calls. Please note the new number below.

Call In [redacted]
Code: [redacted]

Message

From: Matuszko, Jan [Matuszko.Jan@epa.gov]
Sent: 1/12/2018 4:29:47 PM
To: Zomer, Jessica [Zomer.Jessica@epa.gov]
CC: Flanders, Phillip [Flanders.Phillip@epa.gov]
Subject: ELG Plan Briefing package for Dave Ross
Attachments: ELGplanbriefingrossv2.PPTX; Legal Framework for ELGPlan.docx

Importance: High

Here you go.

I was told the materials should get straight to the point. Keep it short and concise. That is why I am planning to communicate some things verbally that used to be on the paper.

Again, sorry to slam you with this!

Message

From: Kim Wagoner [Kim.Wagoner@erg.com]
Sent: 1/12/2018 1:36:02 PM
To: Flanders, Phillip [Flanders.Phillip@epa.gov]
CC: Kimberly Bartell [Kimberly.Bartell@erg.com]; Kim Wagoner [Kim.Wagoner@erg.com]
Subject: Updated 304m budget tracking spreadsheet
Attachments: Budget Review_011118_v2.xlsx

Phillip we have updated the budget tracking spreadsheet per our discussion yesterday (and with our latest spending as of the end of last week). Please note that our hourly rate is actually less than what you were projecting, so we were able to allocate some additional hours to the pilot technology review task.

Please let me know if you have any questions or concerns, otherwise we will use this budget to plan and track our activities going forward.

Kim Wagoner, P.E.
Environmental Engineer
ERG
14555 Avion Parkway Suite 200
Chantilly, VA 20151
703-633-1620

Message

From: Matuszko, Jan [Matuszko.Jan@epa.gov]
Sent: 1/11/2018 8:49:15 PM
To: Wood, Robert [Wood.Robert@epa.gov]
CC: Flanders, Phillip [Flanders.Phillip@epa.gov]; Scozzafava, MichaelE [Scozzafava.MichaelE@epa.gov]
Subject: Draft ELG Plan Briefing for Dave Ross
Attachments: ELGplanbriefingrossdraft1118.PPTX

Didn't QA/QC it, but here you go.

Jan Matuszko
Chief, Engineering and Analytical Support Branch
Office of Water
Environmental Protection Agency
(202) 566-1035

Message

From: Damico, Brian [Damico.Brian@epa.gov]
Sent: 2/19/2019 3:12:21 PM
To: Wood, Robert [Wood.Robert@epa.gov]
CC: Flanders, Phillip [Flanders.Phillip@epa.gov]
Subject: Revised ELG Plan and FRN
Attachments: Draft FRN Prelim Plan 14 20190219Clean.docx; Draft Prelim Plan 14 20190219Clean.docx; Draft FRN Prelim Plan 14 20190219Clean.docx; Draft Prelim Plan 14 20190219Clean.docx

Rob,

Sorry for the delay getting this to you. Phillip gave it to me a while ago. These versions incorporate your edits and should be ready for Deborah review. I also know that Phillip has made significant progress on the blue folder so if you want to ultimately send this to Anna informally or formally we will be ready.

Thanks!

-B

Brian D'Amico
Chief, Technology and Analytical Support Branch
Engineering and Analysis Division
Office of Science and Technology
U.S. Environmental Protection Agency
Washington, DC
(202) 566-1069 (Office)
(202) 384-2190 (EPA Cell)

Message

From: Kim Wagoner [Kim.Wagoner@erg.com]
Sent: 2/13/2019 8:55:52 PM
To: Flanders, Phillip [Flanders.Phillip@epa.gov]
CC: Molly McEvoy [Molly.McEvoy@erg.com]; Kim Wagoner [Kim.Wagoner@erg.com]
Subject: RE: PP14 formatting next week
Attachments: Draft Prelim Plan 14_formatted_clean_021319.docx

Phillip,

Attached is the Plan that has gone through formatting. I accepted all of the changes in this version, but do have a version with the changes tracked (except for the formatting changes) in case you would like to see that. We did run a quick spell check and fixed a few very minor typos. This version should address the printing errors and also helped alleviate some of the odd spacing between tables and sections. Please let me know if you see anything that you would like us to fix before you pass it along.

Kimberly Wagoner, P.E.
Sr. Environmental Engineer
ERG
14555 Avion Parkway, Suite 200
Chantilly, VA 20151
(O) 703-633-1620
(C) 703-328-3392

From: Flanders, Phillip <Flanders.Phillip@epa.gov>
Sent: Monday, February 11, 2019 2:59 PM
To: Kim Wagoner <Kim.Wagoner@erg.com>
Subject: RE: PP14 formatting next week

I attached the edits I added from Rob's review. Please produce a clean version for Deborah to review.

Additionally, I scanned in a couple of pages that have cross reference errors that showed up when the document was printed… but don't appear in the electronic version. Can ERG help figure out why this happens? Since most of our senior reviewers prefer to review hard copies, it is a frustrating issue.

I don't think copy edits are necessary at this point.

From: Kim Wagoner <Kim.Wagoner@erg.com>
Sent: Friday, February 08, 2019 7:34 AM
To: Flanders, Phillip <Flanders.Phillip@epa.gov>
Subject: RE: PP14 formatting next week

Yes that should be fine. Do you want it to go through any kind of a copy edit as well?

Kimberly Wagoner, P.E.
Sr. Environmental Engineer
ERG
14555 Avion Parkway, Suite 200
Chantilly, VA 20151
(O) 703-633-1620
(C) 703-328-3392

From: Flanders, Phillip <Flanders.Phillip@epa.gov>
Sent: Thursday, February 7, 2019 3:55 PM
To: Kim Wagoner <Kim.Wagoner@erg.com>
Subject: PP14 formatting next week

I have Rob's edits to Prelim Plan 14. If I enter them and then pass the file to you can ERG be prepared to quick turn-around a formatted file for Deborah next week? Especially looking at things like table of contents, list of figures, figure numbers, etc. I probably won't be able to get the draft to you until Tuesday at the earliest.

Phillip Flanders, Ph.D., P.E.

Environmental Engineer
Engineering and Analysis Division
Office of Science and Technology
Office of Water

EPA United States Environmental Protection Agency

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(202) 566-8323
www.epa.gov/eg

Message

From: Kim Wagoner [Kim.Wagoner@erg.com]
Sent: 2/13/2019 2:35:05 PM
To: Flanders, Phillip [Flanders.Phillip@epa.gov]; Whitlock, Steve [Whitlock.Steve@epa.gov]; Born, Tom [Born.Tom@epa.gov]; Deborah Bartram [deborah.bartram@erg.com]; Elizabeth Gentile [elizabeth.gentile@erg.com]; Molly McEvoy [Molly.McEvoy@erg.com]
Subject: RE: 304m weekly calls
Attachments: ELG Planning Punch List_021319.xlsx

Good morning! Attached is the updated punch list. In addition for the agenda we have:

- Preliminary Plan 14
    - Deliberative Process / Ex. 5
- PFAS
    - Deliberative Process / Ex. 5
- Nutrients
    - Deliberative Process / Ex. 5
- IWTT
    - Deliberative Process / Ex. 5
- ELG Database
    - Deliberative Process / Ex. 5
- Generic ICR/EGIS
    - Deliberative Process / Ex. 5
- Cost tool/technology review
    - Deliberative Process / Ex. 5
- EJScreen
- Environmental issues analysis
    - Deliberative Process / Ex. 5
- PSC Noncompliance Review
    - Deliberative Process / Ex. 5
- Oil and Gas study record items
    - Deliberative Process / Ex. 5
- Additional ELG planning ideas

Anything else?

Kimberly Wagoner, P.E.
Sr. Environmental Engineer
ERG
14555 Avion Parkway, Suite 200
Chantilly, VA 20151
(O) 703-633-1620
(C) 703-328-3392

-----Original Appointment-----
From: Kim Wagoner
Sent: Wednesday, May 17, 2017 12:44 PM
To: Kim Wagoner; Flanders, Phillip; Whitlock.steve@Epa.gov; Born, Tom; Deborah Bartram; Elizabeth Gentile; Tripp, Anthony; Molly McEvoy
Subject: 304m weekly calls
When: Wednesday, February 13, 2019 11:00 AM-12:00 PM (UTC-05:00) Eastern Time (US & Canada).
Where: Via conference call: [redacted]

All, we have to make a change to our call-in information for our weekly calls. Please note the new number below.

Call In [redacted]
Code: [redacted]

Message

From: Flanders, Phillip [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=0CB247EF96F642F98CB727A9ED48E49E-FLANDERS, P]
Sent: 11/15/2018 8:57:05 PM
To: Kim Wagoner [Kim.Wagoner@erg.com]
Subject: Please clean this version of the plan
Attachments: Draft Prelim Plan 14_111518.docx

Kim,

Can ERG spend the next couple of days cleaning up this version of the plan? I'm sure they'll be more text edits, but there are some formatting things I'd like ERG to address before seeking higher level management review. Please leave comments not addressed to ERG in the document. You'll notice that I intentionally removed the acronym PSC (point source category), Jessica (OGC) thought that was needlessly creating a new acronym in a document that already has lots of acronyms. She couldn't remember having seen it in plans before. She also wanted us to not use ESA for "economic screening analysis" because that is confusing given the more agency-standard meaning of "endangered species act." I attempted to remove that acronym as well. (It should only have existed in that one section.) If you notice any more please go ahead and fix them.

No need to propogate removing "PSC" to any other document (e.g. the full length nutrients report) – it's just to help keep this document more readable. I think this is part of the advantage of having the supporting documents stand alone – we won't have to go back and fix all of this.

If you have to staffing to finish this by Wednesday (11/21) that would be great, otherwise COB Monday (11/19) would also be okay.

Thank you,

Phillip Flanders, Ph.D., P.E.

Environmental Engineer
Engineering and Analysis Division
Office of Science and Technology
Office of Water

EPA United States Environmental Protection Agency

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Message

From:	Flanders, Phillip [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=0CB247EF96F642F98CB727A9ED48E49E-FLANDERS, P]
Sent:	2/11/2019 7:59:01 PM
To:	Kim Wagoner [Kim.Wagoner@erg.com]
Subject:	RE: PP14 formatting next week
Attachments:	Draft Prelim Plan 14_2018.1.29_RobEdits.docx; PrintingErrorExamples.pdf

I attached the edits I added from Rob's review. Please produce a clean version for Deborah to review.

Additionally, I scanned in a couple of pages that have cross reference errors that showed up when the document was printed... but don't appear in the electronic version. Can ERG help figure out why this happens? Since most of our senior reviewers prefer to review hard copies, it is a frustrating issue.

I don't think copy edits are necessary at this point.

From: Kim Wagoner <Kim.Wagoner@erg.com>
Sent: Friday, February 08, 2019 7:34 AM
To: Flanders, Phillip <Flanders.Phillip@epa.gov>
Subject: RE: PP14 formatting next week

Yes that should be fine. Do you want it to go through any kind of a copy edit as well?

Kimberly Wagoner, P.E.
Sr. Environmental Engineer
ERG
14555 Avion Parkway, Suite 200
Chantilly, VA 20151
(O) 703-633-1620
(C) 703-328-3392

From: Flanders, Phillip <Flanders.Phillip@epa.gov>
Sent: Thursday, February 7, 2019 3:55 PM
To: Kim Wagoner <Kim.Wagoner@erg.com>
Subject: PP14 formatting next week

I have Rob's edits to Prelim Plan 14. If I enter them and then pass the file to you can ERG be prepared to quick turn-around a formatted file for Deborah next week? Especially looking at things like table of contents, list of figures, figure numbers, etc. I probably won't be able to get the draft to you until Tuesday at the earliest.

Phillip Flanders, Ph.D., P.E.

Environmental Engineer
Engineering and Analysis Division
Office of Science and Technology
Office of Water

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Message

From: Flanders, Phillip [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=0CB247EF96F642F98CB727A9ED48E49E-FLANDERS, P]
Sent: 11/14/2018 4:34:34 PM
To: Strassler, Eric [Strassler.Eric@epa.gov]
Subject: FW: Final 2016 Plan - Record User's Guide for EPA Website
Attachments: 08544 - Final 2016 Plan User Guide_102518_508.pdf

This is the updated Docket User's Guide for the Final 2016 Plan. I believe it needs to be updated on the website. ERG was already able to update the one in the actual docket.

From: Elizabeth Gentile <Elizabeth.Gentile@erg.com>
Sent: Friday, October 26, 2018 3:44 PM
To: Flanders, Phillip <Flanders.Phillip@epa.gov>
Cc: Kim Wagoner <Kim.Wagoner@erg.com>; Molly McEvoy <Molly.McEvoy@erg.com>; Elizabeth Gentile <elizabeth.gentile@erg.com>
Subject: Final 2016 Plan - Record User's Guide for EPA Website

Phillip:

Attached, please find the revised record user's guide for the Final 2016 Plan. The PDF has been made 508 compliant and is ready for upload to EPA's website. Note – as we discussed, we removed the actual index file and just included a link to the specific PDF at regulations.gov.

Thanks,
Liz

Elizabeth A. Gentile
Environmental Engineer
Eastern Research Group, Inc.
14555 Avion Parkway, Suite 200
Chantilly, VA 20151
elizabeth.gentile@erg.com
Phone: 484-364-4481

Message

From: Flanders, Phillip [Flanders.Phillip@epa.gov]
Sent: 6/18/2018 12:47:28 PM
To: Parikh, Pooja [Parikh.Pooja@epa.gov]
Subject: Re: 304(m) briefing today
Attachments: PrelimPlan14 Briefing_061818.docx

I can call you later this morning, is there a time that works? Here is the briefing package.

From: Parikh, Pooja
Sent: Monday, June 18, 2018 6:34:56 AM
To: Flanders, Phillip
Subject: 304(m) briefing today

Hi Phillip

I noticed that there is a briefing scheduled this afternoon on 304(m); which obviously precedes the pre-brief that we had scheduled for tomorrow. Any chance we can talk before the briefing today? My schedule is fairly clear; I'm teleworking so we'd need to do this by phone. Let me know what works for you. Thanks.

Pooja S. Parikh
Attorney- Advisor
U.S. Environmental Protection Agency
Office of General Counsel, Water Law Office
Phone: 202 564-0839
Email: parikh.pooja@epa.gov

Message

From:	Flanders, Phillip [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=0CB247EF96F642F98CB727A9ED48E49E-FLANDERS, P]
Sent:	6/14/2018 3:30:41 PM
To:	Siddiqui, Ahmar (Siddiqui.Ahmar@epa.gov) [Siddiqui.Ahmar@epa.gov]; Whitlock, Steve [Whitlock.Steve@epa.gov]; Born, Tom [Born.Tom@epa.gov]; Milam, Karen [Milam.Karen@epa.gov]; Damico, Brian [Damico.Brian@epa.gov]
Subject:	FY19 Budget Request
Attachments:	FY19 Budget Request.xlsx

For those of you leading projects under ELG Planning:

We are being asked to come up with a budget request for FY19. I need estimates for the projects you all are leading so I can come up with a number for ELG Planning. Could you all **get back to me by Tuesday (June 19)**? I believe the list of projects that I'm looking for numbers for is:

Limits Lookup Tool
PFAS Deliberative Process / Ex. 5
Nutrients Review
303(d) List Review
Metal Finishing Deliberative Process / Ex. 5
Anything else?

For context I've attached my draft budget request. I realize that all of the numbers in it need to be updated.

Thank you,

Phillip Flanders, Ph.D., P.E.

Environmental Engineer
Engineering and Analysis Division
Office of Science and Technology
Office of Water

Mail Code 4303T
(202) 566-8323
www.epa.gov/eg

Message

From: Flanders, Phillip [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=0CB247EF96F642F98CB727A9ED48E49E-FLANDERS, P]
Sent: 6/6/2018 3:03:32 PM
To: Whitlock, Steve [Whitlock.Steve@epa.gov]
Subject: FW: Quick Turnaround! OS briefing package
Attachments: Prelim 18 ELG Plan Briefing_053018.docx

Importance: High

From: Flanders, Phillip
Sent: Thursday, May 31, 2018 10:58 AM
To: Pritts, Jesse <Pritts.Jesse@epa.gov>; Tripp, Anthony <Tripp.Anthony@epa.gov>; Lewis, Samantha <Lewis.Samantha@epa.gov>; Whitlock, Steve <Whitlock.Steve@epa.gov>
Cc: Damico, Brian <Damico.Brian@epa.gov>
Subject: Quick Turnaround! OS briefing package
Importance: High

I need some help with project status updates for the Options Selection briefing for the Preliminary 2018 ELG Plan. Please provide brief descriptions of your projects that would fit into this briefing. It is really only intended to give a status update to senior management. We are briefing Rob next week, so **please send me descriptions by Tuesday (6/5)**. We are aiming to have the Options Selection meeting with Dave Ross in July.

Thank you,

Phillip Flanders, Ph.D., P.E.

Environmental Engineer
Engineering and Analysis Division
Office of Science and Technology
Office of Water

EPA United States Environmental Protection Agency

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www.epa.gov/eg

Message

From: Flanders, Phillip [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=0CB247EF96F642F98CB727A9ED48E49E-FLANDERS, P]
Sent: 6/5/2018 7:29:10 PM
To: Born, Tom [Born.Tom@epa.gov]
Subject: Help with OS briefing package
Attachments: Prelim 18 ELG Plan Briefing_053018.docx

Importance: High

I need some help with project status updates for the Options Selection briefing for the Preliminary 2018 ELG Plan. Could you provide some brief (1 or 2 sentences) updates for PFAS and 303(d) list project? This is really only intended to give a status update to senior management. Brian and I are briefing Rob on Thursday. We are aiming to have the Options Selection meeting with Dave Ross in July.

Thank you,

Phillip

Message

From: Flanders, Phillip [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=0CB247EF96F642F98CB727A9ED48E49E-FLANDERS, P]
Sent: 5/24/2018 7:59:27 PM
To: Molly McEvoy [Molly.McEvoy@erg.com]
CC: Kim Wagoner [Kim.Wagoner@erg.com]
Subject: RE: Preliminary 2018 Plan Outline
Attachments: Prelim 2018 Plan Outline_052418_pmf.docx

I have comments on this. Would you be able to revise and clean it up by COB Tuesday (5/29)?

Thanks!
Phillip

From: Molly McEvoy [mailto:Molly.McEvoy@erg.com]
Sent: Thursday, May 24, 2018 12:08 PM
To: Flanders, Phillip <Flanders.Phillip@epa.gov>
Cc: Kim Wagoner <Kim.Wagoner@erg.com>
Subject: Preliminary 2018 Plan Outline

Phillip,

Attached, please find a draft Preliminary 2018 Plan outline. The outline includes a few notes to you in bracketed text. Please let us know if you have any questions or comments as you review the outline.

Thanks,
Molly

Molly McEvoy
Environmental Engineer
Eastern Research Group, Inc. (ERG)
Molly.McEvoy@erg.com
Office: (703) 633-1643
Cell: (716) 471-9713

Message

From: Flanders, Phillip [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=0CB247EF96F642F98CB727A9ED48E49E-FLANDERS, P]
Sent: 5/23/2018 7:44:06 PM
To: Milam, Karen [Milam.Karen@epa.gov]
Subject: FW: Most Recent TRA (2015 Annual Review)
Attachments: 2015 ARR_062316_508.pdf; 2015 Final Combined Rankings_rev042315.xlsx

Karen,

These are the results of the most recent Toxics Ranking Analysis (TRA) from the 2015 Annual Review. Hopefully you can use these to compare to your economic screening. Let me know if you need any additional clarification.

Phillip

From: Molly McEvoy [mailto:Molly.McEvoy@erg.com]
Sent: Wednesday, May 23, 2018 3:39 PM
To: Flanders, Phillip <Flanders.Phillip@epa.gov>
Cc: Kim Wagoner <Kim.Wagoner@erg.com>
Subject: Most Recent TRA (2015 Annual Review)

Hi Phillip,

The most recent Toxic Rankings Analysis was performed in 2015 using 2013 DMR and TRI data. I've attached the 2015 Annual Review Report, which contains the results of the 2015 TRA in Section 2.4 (Table 2-9), as well as the Excel file that contains the underlying rankings (see *All Combined Rankings*, *DMR Rankings*, and *TRI Rankings* tabs). Please let us know if you need the data in a different format or have any questions.

Thanks,
Molly

Molly McEvoy
Environmental Engineer
Eastern Research Group, Inc. (ERG)
Molly.McEvoy@erg.com
Office: (703) 633-1643
Cell: (716) 471-9713

United States
Environmental Protection
Agency

The 2015 Annual Effluent Guidelines Review Report

June 2016

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U.S. Environmental Protection Agency
Office of Water (4303T)
1200 Pennsylvania Avenue, NW
Washington, DC 20460

EPA-821-R-16-002

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1. INTRODUCTION TO EPA'S 2015 ANNUAL REVIEW

Effluent limitations guidelines and standards (ELGs) are an essential element of the nation's clean water program, which was established by the 1972 amendments to the Federal Water Pollution Control Act (which then became known as the Clean Water Act (CWA)). ELGs are technology-based regulations used to control industrial wastewater discharges. EPA issues ELGs for new and existing sources that discharge directly to surface waters, as well as those that discharge to publicly owned treatment works (POTWs) (indirect dischargers). ELGs are applied in discharge permits as limits to the pollutants that facilities may discharge. To date, EPA has established ELGs to regulate wastewater discharges from 58 point source categories. This regulatory program substantially reduces industrial wastewater pollution and continues to be a critical aspect of the effort to clean the nation's waters.

In addition to developing new ELGs, the CWA requires EPA to revise existing ELGs when appropriate. Over the years, EPA has revised ELGs in response to developments such as advances in treatment technology and changes in industry processes. To continue its efforts to reduce industrial wastewater pollution and fulfill CWA requirements, EPA conducts an annual review and effluent guidelines planning process. The annual review and planning process has three main objectives: (1) to review existing ELGs to identify candidates for revision, (2) to identify new categories of direct dischargers for possible development of ELGs, and (3) to identify new categories of indirect dischargers for possible development of pretreatment standards.

This report documents EPA's methodology and findings from its 2015 Annual Review. The 2015 Annual Review consisted of three components:

- Conducting a toxicity ranking analysis (TRA) using data from discharge monitoring reports (DMRs) contained in the Integrated Compliance Information System for the National Pollutant Discharge Elimination System (ICIS-NPDES), and the Toxics Release Inventory (TRI). The TRA identifies and prioritizes for further review those industrial categories whose pollutant discharges pose the greatest hazard to human health and the environment relative to other categories. EPA evaluates the relative hazard of these discharges by applying toxic weighting factors (TWFs) to the annual pollutant discharges to calculate the total discharge of toxic pollutants as toxic-weighted pound equivalents (TWPE). See Section 2 of this report for details of the TRA.
- Conducting preliminary category reviews for the industrial categories with the highest hazard potential (in terms of TWPE) identified from the TRA. EPA uses the preliminary category reviews to further evaluate and identify categories that may warrant additional review and study or possible effluent guidelines and standards revision or development. See Section 3 of this report for details on the individual preliminary category reviews.
- Reviewing additional industrial categories and pollutants brought to EPA's attention through public and stakeholder comments and input, to evaluate recent changes within the industries as well as potential new pollutant releases to the environment through industrial wastewater discharge that may not be adequately regulated by

current ELGs. See Section 4 of this report for details on EPA's review of additional industrial categories and pollutants.

The 2015 Annual Review supports EPA's Office of Water's *Preliminary 2016 Effluent Guidelines Program Plan* (Preliminary 2016 Plan) (U.S. EPA, 2016). The Preliminary 2016 Plan, pursuant to Section 304(m) of the CWA, provides background on the CWA and ELG planning process, summarizes the results of the 2015 Annual Review, and details EPA's proposed actions and follow-up. The Preliminary 2016 Plan also identifies any industrial categories newly selected for effluent guidelines rulemaking, and provides a schedule for such rulemaking.

1.1 Introduction References

1. U.S. EPA. 2015. *Final 2014 Effluent Guidelines Program Plan*. Washington, D.C. (July). EPA-821-R-15-001. EPA-HQ-OW-2014-0170-0210.

2. U.S. EPA. 2016. *Preliminary 2016 Effluent Guidelines Program Plan*. Washington, D.C. (June). EPA-821-R-16-001. EPA-HQ-OW-2015-0665. DCN 08208.

2. EPA'S 2015 TOXICITY RANKINGS ANALYSIS (TRA)

Consistent with its odd year review methodology,[1] EPA performed a TRA of all industrial categories, including those subject to existing effluent limitations guidelines and standards (ELGs) and those not currently regulated by ELGs, to identify and prioritize for further review categories whose pollutant discharges may pose the greatest hazards to human health or the environment relative to other categories.

As a first step in the TRA, EPA downloaded 2013 industrial rankings data from the "Top Industrial Dischargers of Toxic Pollutants" area of the DMR Pollutant Loading Tool (the Loading Tool)[2]. EPA used 2013 data to form the basis for the TRA because they represented the most recent and complete set of industrial wastewater discharge data available at the time of the 2015 Annual Review. Section 2.1 describes the industrial rankings data sources and their limitations in detail.

Next, EPA performed a quality review of the data, as discussed in Section 2.2, in order to identify and correct data errors and understand potential outliers. As described in Section 2.3, EPA imported the corrected data into a set of static databases to create the final 2015 point source category rankings. Section 2.4 presents the final 2015 point source category rankings, which EPA used to prioritize categories for further preliminary review. Section 3 of this report presents the methodology for, and findings from, EPA's preliminary category reviews.

2.1 Data Sources and Limitations

The Loading Tool estimates the load of pollutants discharged from specific facilities using a combination of discharge monitoring report (DMR) data, from the Integrated Compliance Information System for the National Pollutant Discharge Elimination System (ICIS-NPDES), and Toxics Release Inventory (TRI) data.[3] TRI and DMR data do not identify the effluent guideline(s) applicable to a particular facility. However, TRI classifies facilities by North American Industry Classification System (NAICS) code, while ICIS-NPDES classifies facilities by Standard Industrial Classification (SIC) codes. Thus, the Loading Tool relates each SIC and NAICS code to an industrial category.[4] It also assigns a relative toxic weighting factor (TWF) to the estimated loads from each facility to calculate the total discharge of toxic pollutants as toxic weighted pound equivalents (TWPE).[5]

The Loading Tool then sums the TWPE for each facility in an industrial category to calculate a total TWPE per category and ranks the categories according to their total TWPE discharged. The Loading Tool's industrial rankings are calculated using the same methodology

[1] EPA's odd year review methodology is further discussed in the *Preliminary 2016 Effluent Guidelines Program Plan* (Preliminary 2016 Plan) (U.S. EPA, 2016).

[2] See the DMR Pollutant Loading Tool, which presents the top industrial dischargers of toxic pollutants. EPA used this section of the DMR Pollutant Loading Tool to inform its 2015 TRA.

[3] Consistent with the methodology presented in the *Technical Support Document for the Annual Review of Existing Effluent Guidelines and Identification of Potential New Point Source Categories* (2009 Screening-Level Analysis (SLA) Report (U.S. EPA, 2009).

[4] For more information on how EPA related each SIC and NAICS code to an industrial category, see Section 5.0 of the 2009 SLA Report (U.S. EPA, 2009).

[5] See a full overview of the DMR Pollutant Loading Tool.

presented in the 2009 Screening Level Analysis (SLA) Report (U.S. EPA, 2009), except for one change to the selection of DMR measurement data from ICIS-NPDES.[6] The calculations specific to the Loading Tool are documented in the *Technical Users Background Document for the Discharge Monitoring Report (DMR) Pollutant Loading Tool* (U.S. EPA, 2012a).

This section provides general information on the use and limitations of the data sources the Loading Tool uses to generate the industrial rankings. These data sources include:

- SIC codes
- NAICS codes
- TWFs
- DMR data from ICIS-NDPES
- TRI data

2.1.1 SIC Codes

The SIC code system was developed to help with the collection, aggregation, presentation, and analysis of data from the U.S. economy (OMB, 1987). The different parts of the SIC code signify the following:

- The first two digits represent the major industry group.
- The third digit represents the industry group.
- The fourth digit represents the industry.

For example, major SIC code 26 (Paper and Allied Products) includes all pulp, paper, and paperboard manufacturing operations. Within SIC code 26, the three-digit SIC codes are used to distinguish the type of facility: 263 for paperboard mills, 265 for paperboard containers and boxes, etc. Within SIC code 265, the four-digit SIC codes are used to separate facilities by product type: 2652 for setup paperboard boxes, 2653 for corrugated and solid fiber boxes, etc.

Although developed to track economic data, the SIC system is used by many government agencies, including EPA, to promote data comparability. In the SIC system, each establishment is classified according to its primary economic activity, which is determined by its principal product or group of products. An establishment may have activities in more than one SIC code. Some data collection organizations track only the primary SIC code for each establishment. ICIS-NPDES includes one four-digit SIC code, reflecting the principal activity causing the discharge at each facility.

EPA does not define the applicability of its ELGs by SIC code, but by industry and process descriptions. For this reason, regulations for an individual point source category may apply to one SIC code, multiple SIC codes, or a portion of the facilities in a SIC code. Therefore, to use data that identify facilities by SIC code, EPA mapped each four-digit SIC code to an appropriate point source category, as summarized in the "SIC/Point Source Category Crosswalk"

[6] The Loading Tool incorporates one change to the selection of DMR measurement data from ICIS-NPDES, described in Section 3.1 of the *2013 Annual Effluent Guidelines Review Report*, which deviates from the methodology described in the 2009 SLA Report (U.S. EPA, 2014a).

table (Table C-1 in Appendix C). The Loading Tool applies this crosswalk to generate the industrial rankings.

EPA has not established national ELGs for all SIC codes. Table C-2 in Appendix C lists the SIC codes for which facility discharge data are available in ICIS-NPDES, but for which EPA could not identify an applicable point source category. For a more detailed discussion, see Section 6 of the 2009 SLA Report (U.S. EPA, 2009).

2.1.2 NAICS Codes

In 1997, the U.S. Census Bureau introduced the NAICS code system, to better represent the economic structure of countries participating in the North American Free Trade Agreement and to remedy deficiencies of the SIC code system. The nomenclature and format of NAICS and SIC codes are presented in Table 2-1.

Table 2-1.Nomenclature and Format of NAICS and SIC Codes

NAICS		SIC	
2-digit	Sector	Letter	Division
3-digit	Subsector	2-digit	Major group
4-digit	Industry group	3-digit	Industry group
5-digit	NAICS industry	4-digit	Industry
6-digit	U.S.-specific industry	N/A	N/A

For example, below are the SIC and NAICS codes for the folding paperboard box manufacturing industry.

In the SIC code system, the classification is less stratified:

- D: Manufacturing;
  - 26: Paper and Allied Paper Products;
    - 265: Paperboard Containers and Boxes;
      - 2657: Folding Paperboard Boxes, Including Sanitary (except paperboard backs for blister or skin packages).

In the NAICS code system the classification is more stratified:

- 32: Manufacturing;
  - 322: Paper Manufacturing;
    - 3222: Converted Paper Product Manufacturing;
      - 32221: Paperboard Container Manufacturing;
        - 322212: Folding Paperboard Box Manufacturing.

The NAICS system is used for industrial classification purposes at many government agencies, including EPA. As in the SIC system, each establishment is classified according to its primary economic activity, which is determined by its principal product or group of products. An establishment may have activities in more than one NAICS code.

EPA does not define the applicability of its ELGs by NAICS code, but by industry and process descriptions. For this reason, regulations for an individual point source category may apply to one NAICS code, several NAICS codes, or a portion of the facilities in one NAICS code. Therefore, to use data that identify facilities by NAICS code, EPA mapped each six-digit NAICS code to an appropriate point source category, as summarized in the "NAICS/Point Source Category Crosswalk" table (Table C-3 in Appendix C). The Loading Tool applies this crosswalk to generate the industrial rankings.

There are some NAICS codes for which EPA has not established national ELGs. Table C-4 in Appendix C lists the NAICS codes for which facility discharge data are available in TRI, but for which EPA could not identify an applicable point source category. For a more detailed discussion, see Section 6 of the 2009 SLA Report (U.S. EPA, 2009).

2.1.3 Toxic Weighting Factors

As part of the Effluent Guidelines Program, EPA developed a wide variety of tools and methods to evaluate effluent discharges. Among these tools is a Toxics Database compiled from over 100 references for more than 1,900 pollutants. The Toxics Database includes aquatic life and human health toxicity data, as well as physical and chemical property data. Each pollutant in this database is identified by a unique Chemical Abstract Service (CAS) number. EPA uses the Toxics Database to calculate a pollutant-specific TWF that accounts for differences in toxicity across pollutants and allows comparison of mass loadings of different pollutants. The Loading Tool uses TWFs to calculate a "toxic-equivalents" loading (in pounds-equivalents per year). The Loading Tool multiplies a mass loading of a pollutant in pounds per year by the TWF to derive a TWPE. The *Toxic Weighting Factors Methodology* memorandum discusses the use and development of TWFs in detail (U.S. EPA, 2012c).

EPA derives TWFs from chronic aquatic life criteria (or toxic effect levels) and human health criteria (or toxic effect levels) established for the consumption of fish. In the TWF method for assessing water-based effects, these aquatic life and human health toxicity levels are compared to a benchmark value that represents the toxicity level of a specified pollutant. EPA chose copper, a metal commonly detected and removed from industrial effluent, as the benchmark pollutant (U.S. EPA, 2012c). During the 2015 Annual Review, EPA did not revise any TWFs or develop TWFs for chemicals that had not previously had them.[7]

2.1.4 Data from ICIS-NPDES

EPA has used DMR data reported to EPA's Permit Compliance System (PCS) as a part of its TRA of existing effluent guidelines since the 2003 Annual Review (68 FRN 75515). Since 2002, EPA has been modernizing PCS by creating a new data system, ICIS-NPDES. ICIS-NPDES automates entering, updating, and retrieving NPDES data, and tracks permit issuance, permit limits, monitoring data, and other data pertaining to facilities regulated by the NPDES program under the CWA. In 2006, states began transitioning their DMR reporting from PCS to ICIS-NPDES. The transition was completed in 2012. By 2012, all states and U.S. territories/tribes have completely migrated to ICIS-NPDES, except New Jersey; thus, New

[7] See documentation maintained within the DMR Loading Tool, for a list of chemicals and their associated TWFs developed by EPA to date.

Jersey has not supplied EPA with required data about its CWA discharge program (U.S. EPA, 2015a). Therefore, the 2013 DMR data do not include data from New Jersey. See Section 2.1.4.2 for more information on this limitation.

More than 250,000 industrial facilities and 17,000 wastewater treatment plants have NPDES individual or general permits[8] for wastewater discharges to waters of the U.S. To provide an initial framework for setting permitting priorities, EPA developed a major/minor classification system for industrial and municipal wastewater discharges. Major discharges usually have the capability to impact receiving waters if not controlled and, therefore, have received more regulatory attention than minor discharges. Permitting authorities classify discharges as major by assessing the following six characteristics (U.S. EPA, 2010):

- Toxic pollutant potential
- Discharge flow: stream flow ratio
- Conventional pollutant loading
- Public health impact
- Water quality factors
- Proximity to coastal waters

Facilities that are major dischargers must report compliance with NPDES permit requirements via monthly DMRs submitted to the permitting authority. The permitting authority enters the reported DMR data into ICIS-NPDES, including pollutant concentrations and quantities, and identifies any permit violations. During the 2015 Annual Review, EPA identified approximately 6,000 facilities (including sewerage systems) classified as major dischargers with DMR data in 2013.

Minor dischargers may or may not adversely impact receiving water if not controlled. Facilities that are minor dischargers must report compliance with NPDES permit requirements via monthly DMRs submitted to the permitting authority; however, EPA does not require the permitting authority to enter data in the ICIS-NPDES database. For this reason, the ICIS-NPDES database includes discharge data only for a limited set of minor dischargers. During the 2015 Annual Review, EPA identified approximately 23,000 facilities (including sewerage systems) classified as minor dischargers with DMR data in 2013.

Parameters in ICIS-NPDES include water quality parameters (such as pH and temperature), specific chemicals, conventional parameters (such as biochemical oxygen demand and total suspended solids), and flow rates. Although other pollutants may be discharged, ICIS-NPDES contains data only for the parameters identified in the facility's NPDES permit. Facilities typically report monthly average concentrations or quantities per day discharged, but may report daily, quarterly, or yearly pollutant measurements, depending on monitoring requirements stated in their permit.

[8] A NPDES individual permit is written to reflect site-specific conditions of a single discharger based on information submitted by that discharger in a permit application. An individual permit is unique to that discharger. NPDES general permits are written to cover multiple dischargers with similar operations and types of discharges based on the permit writer's professional knowledge of those types of activities and discharges (U.S. EPA, 2010).

2.1.4.1 Utility of ICIS-NPDES Data

The data collected in the ICIS-NPDES data system are particularly useful for the ELG planning process for the following reasons:

- ICIS-NPDES is national in scope, including data from 49 states and 21 U.S. territories/tribes.
- Discharge reports included in ICIS-NPDES are based on effluent chemical analysis and metered flows using known analytical methods.
- ICIS-NPDES includes discharge data for facilities in any SIC code.

2.1.4.2 Limitations of ICIS-NPDES Data

Limitations of the data collected in the ICIS-NPDES data system include the following:

- Because New Jersey has not supplied EPA with required discharge monitoring data about its CWA discharge program, the 2013 DMR data do not include discharge monitoring data from this state (U.S. EPA, 2015a). For reference, in 2011, New Jersey accounted for approximately 94,000 TWPE out of a total of 8,930,000 TWPE, with discharges primarily from the Organic Chemicals, Plastics, and Synthetic Fibers (OCPSF) (40 CFR Part 414) and Petroleum Refining (40 CFR Part 419) point source categories.
- The data system contains data only for pollutants a facility is required by permit to monitor; the facility is not required to monitor or report all pollutants actually discharged.
- Data from minor discharges are not comprehensive.
- The data system does not include data characterizing discharges from industrial facilities to publicly owned treatment works (POTWs).
- In some cases, the data system does not identify the type of wastewater (e.g., process wastewater, stormwater, noncontact cooling water) being discharged; therefore, total flow rates reported may include stormwater and noncontact cooling water, as well as process wastewater.
- Pipe identification is not always clear. For some facilities, internal monitoring points are labeled as external outfalls, and ICIS-NPDES may double-count a facility's discharge. In other cases, an outfall may be labeled as an internal monitoring point, and ICIS-NPDES may not include all of a facility's discharge.
- Facilities may not always report the duration of discharge in their DMRs; pollutant loadings are calculated using continuous discharge assumptions (365 days per year), which may overestimate some toxic releases.

- Facilities are identified by SIC code, not point source category. For some SIC codes, it may be difficult or impossible to identify the correct point source category associated with the reported wastewater discharges.[9]
- ICIS-NPDES was designed as a permit compliance tracking system and does not contain production information that would benefit the review of discharges compared to production-based limitations.
- ICIS-NPDES data may be entered into the data systems manually, which leads to data entry errors.
- In ICIS-NPDES data may be reported as an average quantity, maximum quantity, average concentration, maximum concentration, and/or minimum concentration. For many facilities and pollutants, average quantity values are not provided. In these cases, EPA estimates facility loads based on the maximum quantity. Section 3.2.3 of the 2009 SLA Report discusses the maximum quantity issue in detail (U.S. EPA, 2009).

Despite these limitations, EPA determined that the ICIS-NPDES data summarized in the Loading Tool were usable for the 2015 TRA and prioritization of the toxic-weighted pollutant loadings discharged by industrial facilities. The ICIS-NPDES database remains the only data source quantifying regulated pollutants discharged directly to surface waters of the U.S.

2.1.5 Data from TRI

Section 313 of the Emergency Planning and Community Right-to-Know Act requires facilities meeting specified thresholds to report their annual releases and other waste management activities for listed toxic chemicals to the TRI. Facilities must report the quantities of toxic chemicals recycled, collected, combusted for energy recovery, treated for destruction, or otherwise disposed of. Facilities must complete a separate report for each chemical manufactured, processed, or used in excess of the reporting threshold. For the 2015 TRA, EPA used TRI data for reporting year 2013 because they were the most recent data available when the review began.

A facility must meet three criteria to be required to submit a TRI report for a given reporting year:

1. *NAICS Code Determination*. The facility's primary six-digit NAICS code determines if TRI reporting is required. The primary NAICS code is associated with the facility's revenues, and may not relate to its pollutant discharges (71 FR 32464). The TRI-covered industries include six-digit NAICS codes under the following NAICS subsectors or industry groups (U.S. EPA, 2015b):
   - 212, Mining
   - 221, Utilities
   - 31–33, Manufacturing

[9] ICIS-NPDES includes a data field for applicable ELGs; however, completion of this field is not required and it is typically not populated.

- All other miscellaneous manufacturing (includes 1119, 1131, 2111, 4883, 5417, 8114)
- 424, Merchant Wholesalers, Non-durable Goods
- 425, Wholesale Electronic Markets and Agent Brokers
- 511, 512, 519, Publishing
- 562, Hazardous waste
- Federal facilities

2. *Number of Employees*. Facilities must have 10 or more full-time employees or their equivalent (i.e., a total of 20,000 hours or greater worked in a year). EPA defines a "full-time employee" as 2,000 hours per year of full-time equivalent employment (there are several exceptions and special circumstances that are well defined in the TRI reporting instructions) (40 CFR Part 372.3).
3. *Activity Thresholds*. If the facility is in a covered NAICS code and has 10 or more full-time employee equivalents, it must conduct an activity threshold analysis for every chemical and chemical category on the current TRI list. It must determine whether it manufactures, processes, or otherwise uses each chemical at or above the appropriate activity threshold. Reporting thresholds are not based on the amount of release. All TRI thresholds are based on mass, not concentration. Different thresholds apply for persistent, bioaccumulative, toxic (PBT) chemicals than for non-PBT chemicals. Generally, non-PBT chemical threshold quantities are 25,000 pounds for manufacturing and processing activities and 10,000 pounds for other use activities. All thresholds are determined per chemical over the calendar year. For example, mercury compounds are considered PBT chemicals. The TRI reporting guidance requires any facility that manufactures, processes, or otherwise uses 10 grams or more of mercury compounds to report it to TRI (U.S. EPA, 2000).

In TRI, facilities report annual loads released to the environment of each toxic chemical or chemical category that meets reporting requirements. Facilities must report onsite releases or disposal to air, receiving streams, land, underground wells, and several other categories. They must also report the amount of toxic chemicals in wastes transferred to offsite locations, (e.g., POTWs, commercial waste disposal facilities).

Facilities reporting to TRI are not required to sample and analyze waste streams to determine the quantities of toxic chemicals released. They may estimate releases based on mass balance calculations, published emission factors, site-specific emission factors, or other approaches. Facilities are required to indicate, by a reporting code, the basis of their release estimate. TRI's reporting guidance is that, for most chemicals reasonably expected to be present, but measured below the detection limit, facilities should use half the detection limit to estimate the mass released. However, TRI guidance indicates that for dioxins and dioxin-like compounds, non-detects should be treated as zero.

TRI allows facilities to report releases as specific numbers or as ranges, if appropriate. Specific estimates are encouraged if data are available to ensure their accuracy; however, TRI allows facilities to report releases in the following ranges: 1 to 10 pounds, 11 to 499 pounds, and

500 to 999 pounds. If a facility reports a range for a direct or indirect discharge, TRI uses the middle of the range for the TRI output (U.S. EPA, 2013a).

2.1.5.1 Utility of TRI Data

The data collected in TRI are particularly useful for ELG planning for the following reasons:

- TRI is national in scope, including data from all 50 states and U.S. territories/tribes.
- TRI includes releases to POTWs, not just direct discharges to surface water.
- TRI includes discharge data from manufacturing NAICS codes and some other industrial categories.
- TRI includes releases of many toxic chemicals, not just those in facility discharge permits.

2.1.5.2 Limitations of TRI Data

For purposes of ELG planning, limitations of the data collected in TRI include the following:

- Small establishments (fewer than 10 employees) are not required to report, nor are facilities that do not meet the reporting thresholds. Thus, facilities reporting to TRI may be a subset of an industry.
- Release reports are, in part, based on estimates, not measurements. Due to TRI guidance, they may overstate releases, especially at facilities with large wastewater flows.
- Certain chemicals (e.g., polycyclic aromatic compounds (PACs), dioxin and dioxin-like compounds) are reported as a class, not as individual compounds. Because the individual compounds in most classes vary widely in their toxic effects, the potential toxicity of chemical releases can be inaccurately estimated.
- Facilities are identified by NAICS code, not point source category. For some NAICS codes, it may be difficult or impossible to identify the point source category associated with the source of the toxic wastewater releases.
- TRI only requires facilities to report certain chemicals; therefore, all pollutants discharged from a facility may not be captured.

Despite these limitations, EPA determined that the TRI data presented in the Loading Tool were usable for the 2015 TRA and prioritization of the toxic-weighted pollutant loadings discharged by industrial categories.

2.2 <u>Data Quality Review</u>

EPA evaluated the quality of the 2013 DMR and TRI data from the Loading Tool. This evaluation considered data completeness, comparability, accuracy, and reasonableness. The

Environmental Engineering Support for Clean Water Regulations Programmatic Quality Assurance Project Plan (PQAPP) describes the quality objectives in more detail (ERG, 2013).

2.2.1 Data Quality Review and Corrections to the 2013 DMR Data

To evaluate completeness, comparability, accuracy, and reasonableness of the 2013 DMR data, EPA performed the following checks:

Completeness. To evaluate the data's completeness, EPA compared counts of facilities reporting 2011 and 2013 DMR data in the Loading Tool, as shown in Table 2-2.

As mentioned in Section 2.1.4.2, New Jersey has not converted to the current DMR reporting system (ICIS-NPDES), and thus has not supplied EPA with required data about its CWA discharge program for the reporting year 2013 (U.S. EPA, 2015a). As a result, the 2013 DMR data are not complete. However, because the numbers of major and minor facilities reporting DMR data are otherwise similar between 2011 and 2013, EPA determined that the 2013 DMR dataset contained in the Loading Tool was usable for the 2015 Annual Review.

Table 2-2. Results of 2013 DMR Data Completeness Check

Number of Major Industrial Dischargers		Number of Minor Industrial Dischargers	
DMR 2011	DMR 2013	DMR 2011	DMR 2013
1,908	1,938	14,530	16,420

Sources: *DMRLTOutput2013_v1* and *DMRLTOutput2011_v1.*

Comparability. EPA compared the 2011 and 2013 DMR data from the Loading Tool to identify pollutant discharges or wastewater flows that differed more than the year-to-year variation of other chemicals and facilities. EPA used this comparison to determine if quantity, concentration, or flow corrections were appropriate for facility discharges with the highest TWPE. If the comparison was unavailable (e.g., if the pollutant had not been previously reported), EPA contacted the facility or permitting authority.

Accuracy and reasonableness. To evaluate the accuracy and reasonableness of the 2013 DMR data, EPA reviewed the facility and pollutant discharges that had the greatest impact on total category loads and industrial rankings in the Loading Tool, based on toxic-weighted pounds discharged. For each identified facility, EPA used the following steps to review the accuracy and reasonableness of the loads calculated from ICIS-NPDES data:

1. Reviewed database corrections from previous TRAs to determine whether corrections made during previous reviews should apply to the 2013 DMR discharges.
2. Reviewed 2013 DMR facility SIC code information (including the facility's NPDES permit and permit fact sheet) to determine if the facility was assigned to the point source category that best applied to the majority of its discharges, or identified pollutant-level point source category assignments where facilities have operations subject to more than one point source category.
3. Reviewed the Loading Tool's 2013 DMR facility loading calculations, then compared Loading Tool data to data available in EPA's online Envirofacts data system, or from the facility's NPDES permit and permit fact sheet to verify the data. EPA then

calculated annual pollutant loads and compared the results to the 2013 Loading Tool output data to verify the accuracy of the calculated facility loads.

4. Reviewed ICIS-NPDES pipe descriptions available in EPA's online Envirofacts data system, ICIS-NPDES supporting tables, or the facility's NPDES permit and permit fact sheet to identify monitored pollutant discharges that are:
   - Intermittent (e.g., tidal, seasonal, or occurring after a storm).
   - Internal monitoring locations from which wastewater is combined with other waste streams and monitored again, resulting in double-counting loads.
   - Not representative of category discharges (e.g., stormwater runoff from nonprocess areas, noncontact cooling water, or wastewater related to operations in another point source category).
5. Reviewed ICIS-NPDES output data for pollutants that should be excluded from the 2013 DMR load calculation because they are in units that cannot be converted to quantities (e.g., kilograms per day (kg/d)) or concentrations (e.g., milligrams per liter (mg/L)).[10]
6. Contacted the state permitting authority or facility to determine if the data were reported and transcribed correctly.
7. Used the Error Report functionality built into the Enforcement and Compliance History Online (ECHO) website[11] to report identified DMR data errors to the data stewards for evaluation and correction, to ensure that the underlying DMR data pulled into ICIS-NPDES are updated.

Table 2-3 summarizes EPA's initial quality review of the 2013 DMR data. Table D-1 in Appendix D lists all of the specific corrections EPA made to the 2013 DMR data as a result of its data quality review, prior to generating the final 2015 point source category rankings. Note that EPA conducted further quality reviews of the 2013 DMR data, and made additional data corrections, as part of the more detailed preliminary category reviews (presented in Section 3) of this report.

[10] Table A-5 in Appendix A in the *Technical Users Background Document for the Discharge Monitoring Report (DMR) Pollutant Loading Tool* lists pollutants excluded from the Loading Tool (U.S. EPA, 2012a). Examples include: temperature, pH, fecal coliform, and whole effluent toxicity.

[11] See EPA's Enforcement Compliance History Online.

Table 2-3. Summary of 2013 DMR Facility Data Quality Review

Facility	Location	Point Source Category	Pollutant(s) in Question	Review Findings	Action Taken/Database Correction
Equity Group Eufaula Div LLC	Eufaula, AL	Meat and Poultry Products	Cadmium, Copper, Nickel, Zinc	Facility confirmed a concentration error for metals as part of the 2013 Annual Review; concentrations are three orders of magnitude larger than actual values (U.S. EPA, 2014a). December 2013 concentrations for cadmium, copper, nickel, and zinc are three orders of magnitude larger than other months.	Divide December 2013 cadmium, copper, nickel, and zinc concentrations by 1,000.
Nubay Mining, LLC	Galatia, IL	Coal Mining	Flow	EPA identified a unit error for 2011 flow values as part of the 2013 Annual Review. Flow values were three orders of magnitude larger than actual values (U.S. EPA, 2014a). March 2013 flow value for outfall 009 is also three orders of magnitude larger than other months.	Divide March 2013 flow value by 1,000.
PRASA WTP Sabana Grande	Sabana Grande, PR	Drinking Water Treatment	Flow	EPA corrected an outlier flow value for February 2011 for outfall 001 as part of the 2013 Annual Review by dividing by 10,000 to match other months (U.S. EPA, 2014a). December 2013 flow value for outfall 001 is two orders of magnitude higher than other months.	Divide December 2013 flow value by 100.
US Steel Mon Valley Works – Edgar Thomson Plant	Braddock, PA	Iron and Steel Manufacturing	Flow	EPA originally identified a flow correction as part of the 2007 Annual Review (U.S. EPA, 2007); EPA again incorporated the flow correction for the facility as part of the 2013 Annual Review (U.S. EPA, 2014a). The 2013 flow values reviewed for the 2015 Annual Review do not reflect the facility flow correction.	Incorporated facility flow correction and revised 2013 loads for all pollutants.
Celanese LTD Bay City Plant	Bay City, TX	Organic Chemicals, Plastics, and Synthetic Fibers	Total Residual Chlorine	Facility misidentified outfall 001 in DMR data; the outfall is an internal outfall. EPA marked this outfall as an internal outfall as part of the 2013 Annual Review (U.S. EPA, 2014a).	Marked outfall 001 as an internal outfall.

Table 2-3. Summary of 2013 DMR Facility Data Quality Review

Facility	Location	Point Source Category	Pollutant(s) in Question	Review Findings	Action Taken/Database Correction
Aventis Cropscience USA	Institute, WV	Organic Chemicals, Plastics, and Synthetic Fibers	PCBs	The facility confirmed 2011 PCBs concentrations were missing a below detection limit (BDL) indicator as part of the 2013 Annual Review (U.S. EPA, 2014a). EPA determined 2013 PCBs concentrations were also missing the BDL indicator.	Add BDL indicator to 2013 PCBs discharges.
Ed Arey & Sons, Inc.	Buckhannon, WV	Timber Products Processing	Flow	Facility reported incorrect units for the 2009 and 2011 flow values, making the flow values 1,000,000 times larger than previous years (U.S. EPA, 2014a). 2013 flow values are also 1,000,000 larger than previous years.	Divided 2013 flow values by 1,000,000 to match order of magnitude of previous years.
Evergreen Recycling and Disposal	Northwood, OH	Unassigned Waste Facility	Nickel	Facility reported incorrect units for the 2013 nickel concentrations.	Divided 2013 nickel concentrations by 1,000,000,000.
Koppers, Inc.	Gainesville, FL	Timber Products Processing	2,3,7,8-TCDD	State contact confirmed the 2013 DMR TCDD data for outfall 001 (Akhavein, 2014). EPA also confirmed the facility is a Superfund Site by the CERCLIS number.	Facility re-assigned to PSC code 999 – Superfund Sites.
Resolute FP US Inc.[a]	Calhoun, TN	Pulp, Paper and Paperboard	Mercury	Facility contact provided corrected 2013 mercury concentrations (Schwartz and Wiegand, 2014).	Revised 2013 mercury concentrations.
Black Oak Landfill	Hartville, MO	Landfills	Silver, Selenium	State contact confirmed that 2013 DMR silver and selenium concentrations are in units of µg/L, not mg/L (Sappington, 2014).	Divided 2013 silver and selenium concentrations by 1,000.
Graftech International Holdings Inc.	Anmoore, WV	Metal Finishing	Arsenic, Aluminum	Facility contact provided revised 2013 arsenic concentrations for outfall 026 and flow values for outfalls 026, 036, 037, and 038 (Williams, 2014).	Revised 2013 arsenic concentrations for outfall 026 and flow values for outfalls 026, 036, 037, and 038.
BASF Corp	Wyandotte, MI	Organic Chemicals, Plastics, and Synthetic Fibers	Mercury	The March 2013 mercury concentration is six orders of magnitude higher than the other reported concentrations for outfall 002.	Divide the March 2013 concentration by 1,000,000.

Table 2-3. Summary of 2013 DMR Facility Data Quality Review

Facility	Location	Point Source Category	Pollutant(s) in Question	Review Findings	Action Taken/Database Correction
Decker Coal Co.	Decker, MT	Coal Mining	Arsenic	State contact confirmed that the December 2013 arsenic concentration for outfall 002 is non-detect (Self, 2014).	Zeroed December 2013 arsenic concentration for outfall 002.
Aluminum Co. of America Badin	Badin, NC	NFMM	Cyanide	State contact confirmed that 2013 cyanide concentrations are in units of µg/L, not mg/L (Allocco, 2014).	Divided 2013 cyanide concentrations by 1,000.
Mosaic Phosphates Co. Faustina Plant	Donaldsonville, LA	Fertilizer Manufacturing	Fluoride, Cadmium, Aluminum	Facility is a phosphate fertilizer manufacturer, which is subject to 40 CFR Part 418, Subpart A, Phosphate Subcategory. However, because the facility is located in Louisiana, EPA determined it is exempt from Subpart A and permit limits are based on facility-specific permitting.	No data corrections. The facility does not represent the Fertilizer Manufacturing Category because it is exempt from 40 CFR Part 418.
Honeywell International Inc.	Hopewell, VA	Organic Chemicals, Plastics, and Synthetic Fibers	Hexachlorobenzene	Facility contact confirmed that 2013 hexachlorobenzene discharges are below detection (Parker, 2013).	Zeroed 2013 hexachlorobenzene discharges.
DuPont Washington Works	Washington, WV	Organic Chemicals, Plastics, and Synthetic Fibers	Hexachlorobenzene	Confirmed with DMR data provided by the West Virginia Department of Environmental Protection that the hexachlorobenzene discharges are below detection.	Zeroed 2013 hexachlorobenzene discharges.
Ergon West Virginia	Newell, WV	Petroleum Refining	Sulfide	Facility contact provided a revised July 2013 sulfide concentration (Stanton, 2015).	Revised July 2013 sulfide concentration.
Shenango Inc.	Pittsburgh, PA	Iron and Steel Manufacturing	Benzo(a)pyrene	August 2013 benzo(a)pyrene quantity is three orders of magnitude larger than other months and previous years data.	Divided August 2013 benzo(a)pyrene quantity by 1,000.
Feldspar Monticello Plant	Monticello, GA	Mineral Mining and Processing	Flow	November 2013 flow value is five orders of magnitude larger than other months.	Divided November 2013 flow by 100,000.
United Park City Mines Co.	Park City, UT	Ore Mining and Dressing	Mercury	State contact confirmed that 2013 mercury concentrations are in units of ng/L, not mg/L (Thiele, 2015).	Divided October 2013 mercury concentration by 1,000,000.

Table 2-3. Summary of 2013 DMR Facility Data Quality Review

Facility	Location	Point Source Category	Pollutant(s) in Question	Review Findings	Action Taken/Database Correction
Clearon Corp	South Charleston, WV	Inorganic Chemicals Manufacturing	Flow	March and May 2013 flow values are three orders of magnitude larger than other months in 2013 and previous years' data.	Divide March and May 2013 flow values by 1,000.
Clean Harbors Baton Rouge LLC	Baton Rouge, LA	Centralized Waste Treatment	Hexachlorocyclohexane	Confirmed hexachlorocyclohexane discharges are below detection with DMR data from Louisiana (LA DEQ, 2015).	Zeroed 2013 hexachlorocyclohexane discharges.
Henderson City Landfill	Henderson, KY	Landfills	No data corrections.	Facility contact confirmed the outlier cadmium concentration in March 2013 for outfall 001; the facility had a leachate tank flood on the sampling date for this outfall. Therefore, the sample was not a representative sample for the outfall (Anderson, 2015).	No data corrections.
US Ecology Texas Inc.	Robstown, TX	Centralized Waste Treatment	Flow	Facility contact confirmed the outlier flow value in September 2013 for outfall 004; the facility had a large rainfall event in September 2013 and the facility's flow meter was faulty. Therefore, the sample was not a representative sample for the outfall (Camarena, 2015).	

[a] This facility is referred to as Abibow US Inc. in previous annual review reports. In 2012, Abibow US Inc. became Resolute FP US Inc. (Resolute, 2012).

2.2.2 Data Quality Review and Corrections to the 2013 TRI Data

To evaluate completeness, comparability, accuracy, and reasonableness of the 2013 TRI data, EPA performed the following checks:

Completeness. To evaluate the data's completeness, EPA compared counts of facilities reporting 2011 and 2013 TRI data in the Loading Tool, as shown in Table 2-4. Because the number of facilities reporting is similar between 2011 and 2013, EPA determined that the 2013 TRI dataset contained in the Loading Tool was useable for the 2015 Annual Review.

Table 2-4. Results of the 2013 TRI Data Completeness Check

Total Number of Facilities Reporting to TRI		Number of Facilities Reporting Discharges Greater than Zero to TRI	
TRI 2011	TRI 2013	TRI 2011	TRI 2013
18,391	19,601	6,855	6,936

Sources: *TRILTOutput2013_v1 and TRILTOutput2011_v1.*

Comparability. EPA compared the 2013 TRI data from the Loading Tool to 2011 TRI data from the Loading Tool to identify annual pollutant loadings that differed more than the year-to-year variation of other chemicals and facilities. EPA used this comparison to determine if corrections were appropriate for facility discharges with the highest TWPE. If the comparison was unavailable (e.g., the pollutant was not previously reported), EPA contacted the facility.

Accuracy and reasonableness. EPA reviewed facility and pollutant releases that had the greatest impact on total category loads and rankings in terms of TWPE released. For the identified facilities, EPA used the following steps:

1. Reviewed database corrections from previous TRAs to determine whether corrections made during previous reviews should apply to the 2013 TRI releases.
2. Reviewed releases reported to TRI for other reporting years (i.e., 2000, 2002, 2003, 2004, 2005, 2007, 2008, 2009, and 2011) and compared them to releases reported to TRI for reporting year 2013 to identify trends in the discharges.
3. Reviewed 2013 TRI NAICS code information to determine if the facility was assigned to the point source category that best applied to the majority of its discharges, or identified pollutant-level point source category assignments where facilities have operations subject to more than one point source category.
4. Reviewed 2013 DMR data, if available, and hand-calculated annual pollutant loads to compare to releases reported to TRI for reporting year 2013.
5. Verified that the Loading Tool excluded pollutants that should not have an associated pollutant load (e.g., yellow or white phosphorus). See Section 3.4.2 in EPA's *2011 Annual Effluent Guidelines Review Report* (U.S. EPA, 2012b).
6. Contacted the facility to verify whether the pollutant releases are reported correctly.

Through the accuracy review, EPA identified that hydrogen sulfide water releases accounted for approximately 40 percent of the total 2013 TRI TWPE (U.S. EPA, 2015c;

TRILTOutput2013_v0). EPA further evaluated the quality of the hydrogen sulfide data, as hydrogen sulfide is a relatively new pollutant reported to TRI that EPA has not previously considered in its annual reviews and because the data constitutes a large percentage of the TWPE reported to TRI in 2013. EPA evaluated data sources and contacted facilities, summarized in Table 2-5. EPA determined that the data for indirect releases are overestimated based on the estimation techniques used. As a result, EPA identified and adjusted the indirect releases of hydrogen sulfide reported to TRI to account for POTW removals (U.S. EPA, 2015c). See Section 2.2.2.1 for more details on EPA's investigation and adjustment of the 2013 hydrogen sulfide data reported to TRI.

Table 2-5 summarizes EPA's quality review of the 2013 TRI data. Table D-2 in Appendix D of this report lists all of the specific corrections EPA made to the 2013 TRI data as a result of its data quality review, prior to generating the final 2015 point source category rankings. Note that EPA conducted further quality review of the 2013 TRI data and identified additional data corrections as part of the more detailed preliminary category reviews presented in Section 3 of this report.

Table 2-5. Summary of 2013 TRI Facility Data Quality Review

Facility	Location	Point Source Category	Chemical(s) in Questions	Review Findings	Action Taken/Database Correction
International Paper	Georgetown, SC	Pulp, Paper, and Paperboard	Dioxin and dioxin-like compounds	Facility contact confirmed that the TCDD value reported to the 2013 TRI was not detected (Schwartz & Wiegand, 2014).	Zeroed dioxin and dioxin-like compound releases.
ExxonMobil Chemical Baton Rouge Chemical Plant	Baton Rouge, LA	Organic Chemicals, Plastics, and Synthetic Fibers	PACs	As part of the 2013 Annual Review, facility contact confirmed the 2011 TRI PAC releases were estimated from monthly sampling results that were non-detect; therefore, 2011 releases were zeroed (U.S. EPA, 2014a). 2013 releases are similar to 2011.	Zeroed 2013 PAC releases.
Mountain State Carbon	Follansbee, WV	Iron and Steel Manufacturing	PACs	Facility contact confirmed an error in their 2013 PAC release reported to TRI and provided corrected data (Smith, 2015).	Revised PAC release.
USS Gary Works	Gary, IN	Iron and Steel Manufacturing	Lead and lead compounds	Facility contact confirmed an error in their 2013 lead and lead compound release reported to TRI and provided corrected data (Armentrout, 2014).	Revised lead and lead compound release.
Valero Refining	Memphis, TN	Petroleum Refining	Hydrogen Sulfide	Facility contact confirmed the 2013 hydrogen sulfide release and stated that the release was calculated based on monthly sampling results (Brewer, 2014).	No data corrections.
Tesoro Refining	Salt Lake City, UT	Petroleum Refining	Hydrogen Sulfide	Facility contact confirmed that the 2013 hydrogen sulfide release was calculated based on sampling results (Ibarra, 2014).	No data corrections.
Smithfield Farmland Corp	Denison, IA	Meat and Poultry Products	Hydrogen Sulfide	Facility contact confirmed that the 2013 hydrogen sulfide release was calculated based on sampling results (Murphy, 2014).	No data corrections.
Smithfield Farmland Corp	Clinton, NC	Meat and Poultry Products	Hydrogen Sulfide	Facility contact confirmed that the 2013 hydrogen sulfide release was calculated based on sampling results (Murphy, 2014).	No data corrections.
Smithfield Farmland Corp	Smithfield, VA	Meat and Poultry Products	Hydrogen Sulfide	Facility contact confirmed that the 2013 hydrogen sulfide release was calculated based on sampling results (Murphy, 2014).	No data corrections.

Table 2-5. Summary of 2013 TRI Facility Data Quality Review

Facility	Location	Point Source Category	Chemical(s) in Questions	Review Findings	Action Taken/Database Correction
Tyson Fresh Meats Inc.	Logansport, IN	Meat and Poultry Products	Hydrogen Sulfide	Facility contact confirmed the 2013 hydrogen sulfide release and stated that the release was calculated based on sampling results (Dirks, 2015)	No data corrections.
JR Simplot Co	Grand Forks, ND	Canned and Preserved Fruits and Vegetable Processing	Hydrogen Sulfide	Facility contact confirmed the 2013 hydrogen sulfide release and stated that the release was calculated based on sampling results (Prigge, 2014).	No data corrections.
SAPP1 Cloquet LLC	Cloquet, MN	Pulp, Paper, and Paperboard	Hydrogen Sulfide	Facility contact confirmed an error in 2013 hydrogen sulfide releases and provided corrected data (Schwartz & Wiegand, 2014).	Revised hydrogen sulfide release.
Rocktenn CP LLC	Hopewell, VA	Pulp, Paper, and Paperboard	Hydrogen Sulfide	Facility contact confirmed the 2013 hydrogen sulfide release and stated that the release was based on factors provided by the trade association (Schwartz & Wiegand, 2014).	No data corrections.

2.2.2.1 Updates to the 2013 TRI Hydrogen Sulfide Data

During its review of the 2013 TRI data, EPA noted that hydrogen sulfide water releases accounted for approximately 40 percent of the total 2013 TRI TWPE (U.S. EPA, 2015c; *TRILTOutput2013_v0*). Hydrogen sulfide has not historically been included or evaluated as part of EPA's previous annual reviews, but is now included due to recent changes in TRI reporting requirements.

Hydrogen sulfide was added to the TRI list of toxic chemicals in a final rule published on December 1, 1993. On August 22, 1994, EPA issued an Administrative Stay of the reporting requirements for hydrogen sulfide to evaluate issues brought to the Agency's attention after promulgation of the final rule. These issues concerned the human health effect basis for the listing and the Agency's use of exposure analyses in TRI listing decisions. Although the final rule listing hydrogen sulfide under section 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA) remained in force, the stay deferred the reporting requirements for hydrogen sulfide while EPA completed its further evaluation (76 FR 64022).

From its further evaluation of the environmental toxicity of hydrogen sulfide, EPA determined that available data indicate that water with concentrations of more than 2.0 ug/L undissociated hydrogen sulfide would constitute a long-term hazard to aquatic organisms despite its fate under certain environmental conditions (76 FR 64022). As a result, on October 17, 2011, EPA announced it was lifting the Administrative Stay of the reporting requirements for hydrogen sulfide under Section 313 of EPCRA (76 FR 64022). Facilities were required to report environmental releases of hydrogen sulfide to TRI beginning with the reporting year 2012, including releases to water.

EPA's review of the hydrogen sulfide data reported to TRI for the 2015 Annual Review identified five industrial point source categories where hydrogen sulfide contributed a substantial portion of the category TWPE. Table 2-6 lists these point source categories and the percentage of their total category TWPE attributed to hydrogen sulfide. Table 2-7 summarizes the reported 2013 TRI hydrogen sulfide releases by release type (i.e., direct and indirect releases) (U.S. EPA, 2015c).

Table 2-6. Top 2013 TRI Point Source Categories with Reported Hydrogen Sulfide Water Releases

Point Source Category	Total TWPE	H_2S TWPE	Percentage of Total Category TWPE Attributed to H_2S
430 – Pulp, Paper and Paperboard	4,280,000	2,140,000	50%
419 – Petroleum Refining	580,000	191,000	33%
406 – Grain Mills	276,000	274,000	99%
432 – Meat and Poultry Products	213,000	169,000	79%
407 – Canned and Preserved Fruits and Vegetables Processing	68,700	64,200	93%
Total TRI TWPE for Top Categories with Reported Hydrogen Sulfide Releases	**5,420,000**	**2,840,000**	**52%**
Total TRI TWPE	**7,160,000**	**2,870,000**	**40%**

Source: *TRILTOutput2013_v0*

Table 2-7. Summary of 2013 TRI Hydrogen Sulfide Water Releases by Release Type

Type of Release	Number of Facilities Reporting H_2S Releases	Pounds of Reported H_2S Releases	H_2S TWPE
Direct	146	513,000	1,440,000
Indirect	26	511,000	1,430,000
Total H_2S Releases	**172**	**1,024,000**	**2,870,000**
Total TRI TWPE			**7,160,000**

Source: *TRILTOutput2013_v0*

As shown in Table 2-6, hydrogen sulfide releases from five point source categories account for 99 percent of the hydrogen sulfide TRI TWPE and 40 percent of the total TRI TWPE. Table 2-7 shows that the total reported quantity of hydrogen sulfide released (in pounds) is equally distributed between direct and indirect releasing facilities. The data also indicate that a higher number of direct discharging facilities (146) reported releasing hydrogen sulfide as compared to indirect discharging facilities (26).

EPA further evaluated the quality of the hydrogen sulfide data, as hydrogen sulfide is a relatively new pollutant reported to TRI that EPA has not previously considered in its annual reviews, and because the data account for a large percentage of the TWPE reported to TRI in 2013. As a first step in assessing the quality of the hydrogen sulfide data and its utility for the 2015 Annual Review, EPA evaluated whether the reported releases for indirect discharging facilities take into account any treatment and removal that is likely to occur at the receiving POTW. As discussed in Section 3.4 of *Technical Users Background Document for the Discharge Monitoring Report (DMR) Pollutant Loading Tool* (U.S. EPA, 2012a), the Loading Tool adjusts, if possible, the TRI pollutant releases reported by indirect discharging facilities to account for pollutants removed at POTWs prior to release to receiving waters. Table C-1 in Appendix C of the *Technical Users Background Document for the DMR Pollutant Loading Tool* lists the POTW removals used for the TRI chemicals reported as transferred to POTWs (U.S. EPA, 2012a). The adjusted releases are incorporated into the TRI industrial rankings data presented in the "Top Industrial Dischargers of Toxic Pollutants" area of the Loading Tool.

EPA did not identify a removal specific to hydrogen sulfide in Table C-1 in Appendix C of the *Technical Users Background Document for the DMR Pollutant Loading Tool*; therefore, it determined that the 2013 TRI hydrogen sulfide data reported for indirect releasing facilities do not account for treatment occurring at POTWs.

Because hydrogen sulfide in water readily oxidizes to sulfates and is biologically oxidized to elemental sulfur under low to neutral pH and well-aerated conditions (U.S. EPA, 1986, WHO, 2003), hydrogen sulfide removal rates at POTWs are likely to be substantial, which would greatly reduce the amounts of hydrogen sulfide ultimately released to receiving waters. Therefore, EPA determined it was necessary to identify a removal efficiency that it could apply to the indirectly released hydrogen sulfide data reported in TRI, to account for hydrogen sulfide removed at POTWs.

EPA reviewed data sources historically used to develop POTW removals to establish a POTW removal rate for hydrogen sulfide. These data sources include:

- EPA's National Risk Management Research Laboratory (NRMRL) Treatability Database (U.S. EPA, 2004).
- POTW data incorporated into recent ELGs.
- POTW removals incorporated into EPA's Office of Pollution Prevention and Toxics (OPPT) Risk Screening Environmental Indicators (RSEI) model. (Note: EPA relies on the RSEI model for POTW removals only in the absence of actual performance data).

EPA has not made recent updates to the NRMRL Treatability Database, nor has EPA promulgated any more recent ELGs that regulate the release of hydrogen sulfide; therefore, these data sources did not provide any new information regarding POTW removals of hydrogen sulfide.

The RSEI model primarily relies on POTW removals obtained from the NRMRL Treatability Database, but also relies on Syracuse Research Corporation's (SRC's) Sewage Treatment Plant Fugacity Model (STPWIN) for those chemicals not in the NRMRL Treatability Database (U.S. EPA, 2013b). EPA did not identify any recent updates to the NRMRL Treatability Database; therefore, EPA focused its investigation on POTW removal rates for hydrogen sulfide that may be available in the STPWIN model.

EPA downloaded the latest version of SRC's STPWIN model (U.S. EPA, 2013b), which is integrated into EPA's Estimation Program Interface (EPI) Suite[12] (EPI Suite Version 4.11 (November 2012)). The EPI Suite is a suite of physical/chemical property and environmental fate estimation programs developed by the EPA's OPPT and SRC. The STPWIN model in particular predicts the removal of chemicals by typical activated sludge-based sewage treatment plants. The *Hydrogen Sulfide Releases Reported to the Toxics Release Inventory (TRI) in 2013* memorandum discusses the details of the STPWIN model (U.S. EPA, 2015c).

To estimate a hydrogen sulfide POTW removal, EPA entered the chemical properties for hydrogen sulfide into the STPWIN and used the default option for the degradation half-life of hydrogen sulfide, which provides a conservative removal rate. The resulting POTW removal for hydrogen sulfide calculated by the STPWIN model is 98.64 percent.

To gather additional data on POTW removals of hydrogen sulfide and confirm the POTW removal rate calculated by the STWPIN model, EPA contacted Lafayette Wastewater Treatment Plant, in Lafayette, IN, a POTW that receives wastewaters from industrial facilities reporting releases of hydrogen sulfide to TRI. EPA also contacted the City of Tolleson Wastewater Treatment Plant, in Tolleson, AZ, which reported hydrogen sulfide discharges on its DMR.

The Lafayette Wastewater Treatment Plant did not have any treatment data for hydrogen sulfide and was not concerned about hydrogen sulfide loads received from industrial facilities (Beeler, 2014). The City of Tolleson Wastewater Treatment Plant provided 2013 and 2014 hydrogen sulfide treatment data: raw influent hydrogen sulfide concentrations range from 0.23 – 0.742 mg/L, and the treated effluent concentrations are 0.01 mg/L or less (Tyler, 2014). These

[12] See the EPI Suite - Estimation Program Interface for more information and to download the model.

data indicate a hydrogen sulfide percent removal at the POTW ranging from 95.7 to 98.7 percent. This suggests that EPA can reasonably apply the estimated removal rate of 98.64 percent obtained from the STPWIN model to adjust the indirect releases of hydrogen sulfide reported to TRI.

Thus, EPA applied a POTW removal rate of 98.64 percent to the hydrogen sulfide release data reported to TRI in 2013 and used the adjusted releases in the development of the final 2015 point source category rankings. Table B-1 in Appendix B lists the facilities with indirect hydrogen sulfide releases adjusted to account for POTW removals. Incorporating the POTW removal rate for the hydrogen sulfide releases reduces the total 2013 hydrogen sulfide TRI TWPE to 19,500.

EPA evaluated the data quality associated with direct releases of hydrogen sulfide reported to TRI in 2013 as part of its preliminary reviews, specifically for the Grain Mills, Meat and Poultry Products, and Pulp, Paper, and Paperboard point source categories (see Sections 3.3, 3.6, and 3.11 of this report, respectively).

2.3 Generation of the Final 2015 Point Source Category Rankings

EPA incorporated the corrected data, discussed in Sections 2.2.1 and 2.2.2, into a set of databases, *DMRLTOutput2013_v1* and *TRILTOutput2013_v1*, designed to preserve the integrity of the data and subsequent analyses supporting the 2015 Annual Review. These databases are static, while the Loading Tool is based on a dynamic dataset that can change over time. (For example, evolving reporting requirements may affect the population of facilities reporting to ICIS-NPDES and facilities may report data corrections as they are identified). Tables E-1 and E-2 in Appendix E present the TRI and DMR point source category rankings by TWPE from the *TRIOutput2013_v1* and *DMRLTOutput2013_v1* databases, respectively. Additionally, Tables E-3 and E-4 in Appendix E present the six-digit NAICS code rankings by TWPE from *TRIOutput2013_v1* and the four-digit SIC code rankings by TWPE from *DMRLTOutput2013_v1*, respectively. Tables E-5 and E-6 in Appendix E present the chemical rankings by TWPE from *TRIOutput2013_v1* and *DMRLTOutput2013_v1*, respectively.

To generate the final combined 2015 point source category rankings, EPA consolidated the 2013 DMR and TRI point source category rankings into one dataset using the following steps:

- EPA combined the two lists of point source categories by adding each category's *DMRLTOutput2013-_v1* TWPE and *TRILTOutput2013-_v1* TWPE.[13]
- EPA ranked the point source categories based on the total *DMRLTOutput2013-_v1* and *TRILTOutput2013-_v1* TWPE.

In addition, EPA eliminated from further consideration the results for the following:

[13] Combining DMR and TRI loads may result in "double-counting" of chemical discharges if a facility reported to both ICIS-NPDES and TRI, and "single-counting" of chemicals reported in only one of the data sources. Further, the combined TWPE do not count chemicals that may be discharged but are not reported to ICIS-NPDES or TRI.

- Discharges from industrial categories for which EPA promulgated or revised ELGs within the past seven years. See Section 2.3.1 for details on these categories.
- Discharges from facilities that require a NPDES permit but do not fall into an existing or new point source category or subcategory (e.g., Superfund sites). See Section 2.3.2 for details on these facilities.

The final combined 2015 point source category rankings represent the results of the 2015 TRA and are presented in Section 2.4.

2.3.1 Categories for Which EPA Has Recently Promulgated or Revised ELGs

In its 2015 TRA and subsequent preliminary category reviews, EPA did not consider industrial categories for which ELGs were recently established or revised but are not yet fully implemented. In general, EPA removes an industrial point source category from further consideration during a review cycle if EPA established or revised the category's ELGs within seven years of the annual reviews. This seven-year period allows time for the ELGs to be incorporated into NPDES permits. Table 2-8 lists the categories EPA excluded from the 2015 Annual Review due to this seven-year period.

Table 2-8. Point Source Categories That Have Undergone Recent Rulemaking

40 CFR Part	Point Source Category	Date of Rulemaking
450	Construction and Development	December 1, 2009 Revised March 6, 2014
449	Airport Deicing	May 16, 2012
423	Steam Electric Power Generating	September 30, 2015

In addition, EPA did not consider in its 2015 TRA and subsequent preliminary category reviews industrial categories or subcategories that are subjects of an ongoing rulemaking process. These include the Canned and Preserved Seafood Category (covering the Alaskan seafood processing subcategories), dental practices (specifically, relating to the discharge of mercury found in dental amalgam), and the Oil and Gas Extraction Category, specifically relating to the discharge of pollutants from unconventional oil and gas extraction facilities. See Section 5 of the Preliminary 2016 Plan (U.S. EPA, 2016) for details on the rulemaking status of these categories.

Industrial categories or subcategories for which EPA had recently considered developing or revising ELGs were not reviewed by EPA in its final 2015 point source category rankings and TRA. This is because EPA thoroughly reviewed these categories separately from the annual review process. This includes a subcategory of facilities that produce chlorine and chlorinated hydrocarbons (CCH) that fall into the Organic Chemicals, Pesticides, and Synthetic Fibers (40 CFR Part 414) and Inorganic Chemicals Manufacturing (40 CFR Part 415) point source categories. Similarly, EPA did not review coalbed methane extraction in the Oil and Gas Extraction Category (40 CFR Part 435). See Section 5 of EPA's *Final 2012 and Preliminary 2014 Effluent Guidelines Program Plans* (U.S. EPA, 2014) for details on EPA's determinations related to these categories.

2.3.2 Discharges Not Categorizable

EPA identified some discharges that are not categorizable into existing or new point source categories or subcategories. As part of the 2011 Annual Review, EPA reviewed high TWPE discharges from a Superfund site (Auchterlonie, 2009; U.S. EPA, 2012). Direct discharges from Superfund sites, whether made on site or off site, are subject to NPDES permitting requirements (U.S. EPA, 1988a, 1988b). For the reasons discussed below, EPA continued to determine that these discharges cannot be categorized into a single point source category, and excluded these TWPE from the final 2015 point source category rankings.

EPA determined that discharges from Superfund sites are too varied to be categorized into a single point source category. In particular, they vary by:

- Contaminants (e.g., metals, pesticides, dioxin).
- Treatment technologies (e.g., air stripping, granular activated carbon, chemical/ultraviolet oxidation, aerobic biological reactors, chemical precipitation).
- Types of facilities causing groundwater contamination (e.g., wood treatment facilities, metal finishing and electroplating facilities, drum recycling facilities, mines, mineral processing facilities, radium processing facilities).
- In addition, the duration and volume of Superfund site direct discharges vary significantly due to differences in aquifer characteristics and in the magnitude, fate, and transport of contaminants through aquifers and vadose zones.

Currently, permit writers for Superfund sites determine technology-based effluent limits using their best professional judgment. The permit must also call for more stringent effluent limitations, if necessary, to comply with state water quality standards. EPA finds that the current site-specific, best professional judgment approach is workable and flexible within the context of a Superfund cleanup (U.S. EPA, 2012).

2.4 Results of the 2015 Toxicity Rankings Analysis

Table 2-9 presents the final 2015 combined point source category rankings that support EPA's 2015 TRA and Annual Review. The data in the table take into account all corrections and updates discussed in Sections 2.2.1 and 2.2.2. Table 2-9 also reflects the removal of any categories and discharges, as discussed in Section 2.3. As described in Section 3, EPA used these rankings to prioritize categories for further preliminary review.

Table 2-9. Final 2015 Combined Point Source Category Rankings

PSC Code	PSC Description	TRI TWPE	DMR TWPE	Total TWPE	Cumulative Percentage of Total TWPE	Rank
430	Pulp, Paper and Paperboard	2,190,000	321,000	2,510,000	30.1%	1
NA	Drinking Water Treatment	0	892,000	892,000	40.8%	2
415	Inorganic Chemicals Manufacturing[a]	794,000	94,200	888,000	51.4%	3
419	Petroleum Refining	419,000	242,000	661,000	59.4%	4
414	Organic Chemicals, Plastics and Synthetic Fibers[a]	333,000	301,000	634,000	67.0%	5
418	Fertilizer Manufacturing	8,500	568,000	577,000	73.9%	6
420	Iron and Steel Manufacturing	84,600	188,000	273,000	77.2%	7
421	Nonferrous Metals Manufacturing	34,300	187,000	221,000	79.8%	8
406	Grain Mills	179,000	22,300	201,000	82.2%	9
445	Landfills	235	166,000	166,000	84.2%	10
435	Oil and Gas Extraction	0	163,000	163,000	86.2%	11
436	Mineral Mining and Processing	4,710	139,000	144,000	87.9%	12
440	Ore Mining and Dressing	82,700	57,700	140,000	89.6%	13
433	Metal Finishing	46,900	73,500	120,000	91.0%	14
NA	Miscellaneous Foods and Beverages	5,030	105,000	110,000	92.3%	15
410	Textile Mills	2,210	89,500	91,700	93.4%	16
432	Meat and Poultry Products	81,500	8,220	89,700	94.5%	17
458	Carbon Black Manufacturing	63,800	0.0998	63,800	95.3%	18
437	Centralized Waste Treatment	2,720	59,700	62,400	96.0%	19
NA	Unassigned Waste Facility	13,000	34,000	47,000	96.6%	20
434	Coal Mining	386	40,200	40,600	97.1%	21
409	Sugar Processing	406	32,500	32,900	97.5%	22
422	Phosphate Manufacturing	2,340	23,900	26,200	97.8%	23
429	Timber Products Processing	22,500	2,980	25,500	98.1%	24
455	Pesticide Chemicals	19,000	3,760	22,700	98.4%	25
438	Metal Products and Machinery	17,400	2,010	19,400	98.6%	26
471	Nonferrous Metals Forming and Metal Powders	12,300	1,070	13,400	98.8%	27
424	Ferroalloy Manufacturing	12,100	283	12,400	98.9%	28
428	Rubber Manufacturing	7,410	4,120	11,500	99.0%	29
439	Pharmaceutical Manufacturing	2,670	6,500	9,170	99.2%	30
468	Copper Forming	5,840	2,440	8,280	99.3%	31
463	Plastics Molding and Forming	1,830	6,030	7,860	99.4%	32
464	Metal Molding and Casting (Foundries)	3,460	3,890	7,350	99.4%	33
444	Waste Combustors	88.8	7,210	7,300	99.5%	34

Table 2-9. Final 2015 Combined Point Source Category Rankings

PSC Code	PSC Description	TRI TWPE	DMR TWPE	Total TWPE	Cumulative Percentage of Total TWPE	Rank
407	Canned and Preserved Fruits and Vegetables Processing	5,340	660	6,000	99.6%	35
411	Cement Manufacturing	381	5,600	5,980	99.7%	36
405	Dairy Products Processing	4,270	481	4,750	99.7%	37
413	Electroplating	4,620	0	4,620	99.8%	38
469	Electrical and Electronic Components	3,030	171	3,200	99.8%	39
NA	Printing and Publishing	27.6	2,110	2,140	99.8%	40
425	Leather Tanning and Finishing	1,400	506	1,910	99.9%	41
451	Concentrated Aquatic Animal Production	0	1,530	1,530	99.9%	42
457	Explosives Manufacturing	1,130	386	1,520	99.9%	43
467	Aluminum Forming	857	657	1,510	99.9%	44
417	Soap and Detergent Manufacturing	1,260	148	1,410	99.9%	45
442	Transportation Equipment Cleaning	71.7	1,270	1,340	100.0%	46
461	Battery Manufacturing	934	227	1,160	100.0%	47
426	Glass Manufacturing	522	133	655	100.0%	48
NA	Independent and Stand Alone Labs	0	542	542	100.0%	49
460	Hospitals	0	536	536	100.0%	50
443	Paving and Roofing Materials (Tars and Asphalt)	190	93.6	283	100.0%	51
446	Paint Formulating	94.8	0.437	95.3	100.0%	52
454	Gum and Wood Chemicals Manufacturing	26.4	62.4	88.8	100.0%	53
465	Coil Coating	79.1	0.0925	79.2	100.0%	54
NA	Food Service Establishments	0	35.5	35.5	100.0%	55
447	Ink Formulating	19.6	0.0103	19.7	100.0%	56
466	Porcelain Enameling	7.82	0	7.82	100.0%	57
NA	Tobacco Products	5.32	0.167	5.48	100.0%	58
412	Concentrated Animal Feeding Operations	0	1.49	1.49	100.0%	59
427	Asbestos Manufacturing	0	0.589	0.589	100.0%	60
NA	Industrial Laundries	0	0	0	100.0%	61
Total		**4,480,000**	**3,860,000**	**8,340,000**		

Sources: *DMRLTOutput2013_v1* and *TRILTOutput2013_v1*.

Note: Sums of individual values may not equal the total presented, due to rounding.

NA: Not applicable.

[a] The Organic Chemicals, Pesticides, and Synthetic Fibers and Inorganic Chemicals Manufacturing point source categories do not include discharges from facilities that produce chlorine and chlorinated hydrocarbons because EPA recently reviewed this category separately from the annual review process.

2.5 References for EPA's Toxicity Rankings Analysis

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3. EPA'S 2015 PRELIMINARY CATEGORY REVIEWS

Based on its toxicity rankings analysis (TRA) described in Section 2, EPA was able to prioritize for further review those industrial categories whose pollutant discharges potentially pose the greatest hazards to human health or the environment because of their toxicity. To identify these industrial categories, EPA calculated each industrial category's percent of the total toxic-weighted pound equivalents (TWPE). As shown in Table 2-9, EPA identified and focused its preliminary category reviews on the 18 industrial categories that collectively discharge over 95 percent of the total TWPE.

EPA documented the quality of the data supporting its preliminary review of these industrial categories, analyzed how the data could be used to characterize the industrial wastewater discharges, and prioritized the findings for further review. See Appendix A of this report for more information on data usability and quality of the data sources supporting these reviews.

3.1 Prioritization of Categories for Preliminary Category Review

EPA excluded Petroleum Refining (40 CFR Part 419) and Metal Finishing (40 CFR Part 433) from further preliminary category review because it is currently conducting ongoing detailed and preliminary studies of these categories, respectively, as announced in the *Final 2014 Effluent Guidelines Program Plan* (U.S. EPA, 2015).

Based on its knowledge of the annual review process; data from the Integrated Compliance Information System for the National Pollutant Discharge Elimination System (ICIS-NPDES), and the Toxics Release Inventory (TRI); and historical data changes, EPA determined that five of the remaining 16 categories did not warrant a detailed preliminary category review as part of the 2015 Annual Review. For these five categories, many of which have been reviewed in detail in prior annual reviews, EPA found that one facility accounts for the majority of the category TWPE. From data available for the 2015 Annual Review, EPA determined that the discharges from that facility either are the result of an easily identifiable error or do not represent the category. These industrial categories, and the reasons for excluding them from further preliminary review, are briefly discussed in Sections 3.1.1 through 3.1.5, below.

For each of the remaining 11 categories (of the top 18 that collectively discharge over 95 percent of the total TWPE), EPA did not initially identify obvious data entry errors and/or determined that the TWPE was attributed to multiple pollutants and facilities. Therefore, EPA completed a preliminary review for these categories to determine whether the discharges warrant further review and study and/or possible revisions to the effluent limitations guidelines and standards. The findings from EPA's preliminary category reviews are discussed in the following subsections of this report. The 11 industrial categories identified for detailed preliminary category reviews are listed below and discussed in Sections 3.2 through 3.12:

- Carbon Black Manufacturing (40 CFR Part 458)
- Grain Mills (40 CFR Part 406)
- Iron and Steel Manufacturing (40 CFR Part 420)
- Landfills (40 CFR Part 445)

- Meat and Poultry Products (40 CFR Part 432)
- Mineral Mining and Processing (40 CFR Part 436)
- Nonferrous Metals Manufacturing (40 CFR Part 421)
- Ore Mining and Dressing (40 CFR Part 440)
- Organic Chemicals, Plastics, and Synthetic Fibers (40 CFR Part 414)
- Pulp, Paper, and Paperboard (40 CFR Part 430)
- Textile Mills (40 CFR Part 410)

3.1.1 Drinking Water Treatment (potential new category)

The Drinking Water Treatment (DWT) Category total TWPE is composed entirely of 2013 discharge monitoring report (DMR) discharges. The 2013 DMR top pollutant is total residual chlorine. EPA identified one facility, Wyndham Sugar Bay Resort in St. Thomas, VI, which accounts for over 80 percent of the 2013 DMR total residual chlorine TWPE for the DWT Category. As part of the 2015 Annual Review, EPA Region 2 confirmed Wyndham Sugar Bay Resort's total residual chlorine discharges. The 2013 DMR total residual chlorine data is above the facility's permit limits. Additionally, the facility has submitted intermittent total residual chlorine DMR discharge data from 2010 through 2013. The EPA Region 2 contact stated that data from all facilities in the Virgin Islands is historically incomplete (Louis, 2015). EPA determined that the data do not support the need to review further the DWT Category.

3.1.2 Fertilizer Manufacturing (40 CFR Part 418)

The Fertilizer Manufacturing Category total TWPE is composed almost entirely of DMR discharges, and the top 2013 DMR pollutant is fluoride. EPA identified one facility, Mosaic Fertilizer LLC, in Uncle Sam, LA, which accounts for 89 percent of the 2013 DMR fluoride TWPE for the Fertilizer Manufacturing Category. Mosaic Fertilizer LLC is a phosphate fertilizer manufacturer. Phosphate fertilizer manufacturers are subject to 40 CFR Part 418 Subpart A, "Phosphate Subcategory." The facility was reviewed as part of the 2010, 2011, and 2013 Annual Reviews. During those reviews, EPA determined that, in accordance with 40 CFR Part 418, the facility is exempt from Subpart A and that permit limits are based on facility-specific permitting (U.S. EPA 2011, 2012, 2014). Further, fluoride discharges for the facility have decreased from discharge years 2011 to 2013 (534,000 TWPE in 2011, 490,000 TWPE in 2013). Therefore, EPA makes a similar finding as previous annual reviews: Mosaic Fertilizer LLC does not represent the Fertilizer Category because it is exempt from 40 CFR Part 418 (see 52 FR 28428, July 29, 1987). EPA determined that the data do not support the need to review further the Fertilizer Manufacturing Category.

3.1.3 Inorganic Chemicals Manufacturing (40 CFR Part 415)

For the Inorganic Chemicals Manufacturing (Inorganic Chemicals) Category, the 2013 TRI TWPE accounts for 89 percent of the combined DMR and TRI TWPE. As a result, EPA focused on 2013 TRI data. The top 2013 TRI pollutant is cadmium and cadmium compounds. EPA determined that one facility, PCS Nitrogen Fertilizer LP, in Geismar, LA, accounts for over 99 percent of the 2013 TRI cadmium and cadmium compounds TWPE for the Inorganic Chemicals Category. As part of the 2015 Annual Review, EPA contacted the facility. The facility contact confirmed the 2013 TRI cadmium and cadmium compound releases and stated that the source of the metals in the wastewater was from the raw materials used in the phosphoric acid production processes, which contain low levels of naturally occurring metals. For one of three outfalls, the facility estimates cadmium and cadmium compound releases using monthly concentrations multiplied by the annual flow. This outfall comprises the majority of the TRI cadmium and cadmium compound releases reported to TRI and consists of inactive storage pile runoff and excess stormwater runoff. For the other two outfalls, the facility bases estimations on historical concentrations multiplied by the annual flow. All three of the outfalls used in determining the cadmium and cadmium compound releases to TRI are internal outfalls (Hopper, 2014). The facility has a NPDES permit, with cadmium monitoring only requirements for one of the internal outfalls only. Since the cadmium and cadmium compound releases from PCS Nitrogen Fertilizer are from internal outfalls, they are not accounted for in the facility's DMR loadings. The facility is in the process of obtaining a revised permit. EPA determined that the data do not represent the Inorganic Chemicals Category.

3.1.4 Miscellaneous Foods and Beverages (potential new category)

The Miscellaneous Foods and Beverages Category total TWPE is composed almost entirely of DMR discharges and the top 2013 DMR pollutant is sulfide. EPA identified one facility, Bacardi Corporation, in Catano, PR, which accounts for over 97 percent of the 2013 DMR sulfide TWPE for the Miscellaneous Foods and Beverages Category. EPA previously reviewed sulfide discharges from Bacardi Corporation as part of the 2010 Annual Review. At that time, EPA determined that the facility's sulfide discharges were unique to the facility and certain pollutants, such as sulfide, are discharged below permit limits and combined with waste streams from adjacent wastewater treatment plants prior to reaching surface water (U.S. EPA, 2011). As part of the 2015 Annual Review, EPA Region 2 confirmed Bacardi Corporation's 2013 DMR sulfide discharges. The EPA Region 2 contact also stated that the facility's wastewater treatment and permit limits have not changed in recent years and the sulfide concentrations result from molasses used to make rum (Lantner, 2015). The 2013 DMR sulfide discharges meet the facility's permit limits. For these reasons, EPA determined that the sulfide discharges from Bacardi Corporation are unique to the facility and do not represent the Miscellaneous Foods and Beverages Category.

3.1.5 Oil and Gas Extraction (40 CFR Part 435)

For the Oil and Gas Extraction (Oil and Gas) Category, the 2013 DMR TWPE accounts for 100 percent of the combined DMR and TRI TWPE. As a result, EPA focused on 2013 DMR data. The top 2013 DMR pollutant is sulfide, accounting for over 93 percent of the total DMR TWPE for the Oil and Gas Category. EPA determined that one facility, Maverick Spring, in Cody, WY, accounts for over 99 percent of the 2013 DMR sulfide TWPE. EPA determined that this facility is a conventional oil and gas extraction facility, and therefore, further reviewed the facility as part of the 2015 Annual Review.[14] The facility discharges sulfide from outfall 001; the facility's NPDES permit includes monitoring only requirements for sulfide from outfall 001. As part of the 2015 Annual Review, Region 8 confirmed Maverick Spring's 2013 DMR sulfide

[14] EPA recently reviewed coal bed methane facilities separately from the annual review process. Additionally, EPA is currently engaged in a rulemaking process for unconventional oil and gas extraction facilities. Therefore, coal bed methane and unconventional oil and gas extraction facilities were not further reviewed in EPA's review of the Oil and Gas Extraction Category.

discharges and indicated that the facility's permit is currently under revision (Lozano, 2014). Additionally, Maverick Spring's sulfide discharges have increased from 2011 to 2013. EPA determined that the data do not support the need to further review the Oil and Gas Extraction Category.

3.1.6 References for the Prioritization of Categories for Preliminary Category Review

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3.2 Carbon Black Manufacturing (40 CFR Part 458)

EPA identified the Carbon Black Manufacturing (Carbon Black) Category for preliminary review because it ranks high, in terms of toxic-weighted pound equivalents (TWPE), in the final 2015 combined point source category rankings. EPA has not completed a preliminary category review of the Carbon Black Category as part of recent annual reviews because it has not historically been a category that collectively contributed to the top 95 percent of the total TWPE in the point source category rankings. However, EPA has reviewed and made data corrections for facility-specific discharges as part of previous toxicity rankings analyses (TRA). This section summarizes the results of the 2015 Annual Review. EPA focused its 2015 review on discharges of polycyclic aromatic compounds (PACs) because of their high TWPE relative to the other pollutants discharged by facilities in the Carbon Black Category.

3.2.1 Carbon Black Category 2015 Toxicity Rankings Analysis

Table 3-1 compares the TRA data for the Carbon Black Category from the 2011, 2013, and 2015 Annual Reviews. EPA did not conduct the TRA in 2012 or 2014, but instead reviewed additional data sources as part of the even-year annual review, as described in Section 2.2.1 of EPA's Preliminary 2016 Plan (U.S. EPA, 2016). As discussed in this section, during the 2015 Annual Review, EPA identified a data correction that affected the 2013 Toxic Release Inventory (TRI) data and TWPE. The bottom row of Table 3-1 shows the corrected data resulting from this review.

Table 3-1. Carbon Black Category TRI and DMR Facility Counts and Discharges Reported in 2009, 2011, and 2013

Year of Discharge	Year of Review	Carbon Black Category Facility Counts[a]			Carbon Black Category TWPE		
		Total TRI Facilities	Total DMR Major Facilities	Total DMR Minor Facilities	TRI TWPE[b]	DMR TWPE[c]	Total TWPE
2009	2011	5	0	3	62,300	65.9	62,400
2011	2013	4	0	1	27,900	0.2	27,900
2013	2015	3	0	1	63,800[d]	0.1	63,800[d]
					38,500[e]		38,500[e]

Sources: *DMRLoads2009_v2* (for 2009 DMR); *TRIReleases2009_v2* (for 2009 TRI); *DMRLTOutput2011_v1* (for 2011 DMR); *TRILTOutput2011_v1* (for 2011 TRI); *DMRLTOutput2013_v1* (for 2013 DMR); *TRILTOutput2011_v3* (for 2013 TRI).

Note: EPA did not evaluate 2010 or 2012 DMR and TRI data.

Note: TWPE values are rounded to three significant figures. Sums of individual values may not equal the total presented, due to rounding.

a Number of facilities with TWPE greater than zero.

b Releases include direct discharges to surface waters and transfers to POTWs. Transfers to POTWs account for POTW removals.

c Includes DMR data from both major and minor dischargers.

d 2013 data prior to corrections made during the 2015 Annual Review.

e 2013 data after corrections were made during the 2015 Annual Review.

As shown in Table 3-1, the TWPE for TRI decreased from 2009 to 2011 and then increased from 2011 to 2013, even while the number of facilities reporting has dropped. The increase in TRI TWPE is primarily due to releases from facilities described in the sections below.

3.2.2 Carbon Black Category Pollutants of Concern

EPA's 2015 review of the Carbon Black Category focused on 2013 TRI releases because the TRI data dominate the category's combined TWPE. Table 3-2 shows the five pollutants with the highest contribution to the 2013 TRI TWPE. Table 3-2 also presents the 2013 TRI TWPE after EPA corrected errors identified in this preliminary category review (discussed in the sections below). As a point of comparison, Table 3-2 shows the 2011 TRI facility count and TWPE for these top five pollutants, based on the 2013 Annual Review (U.S. EPA, 2014).

PACs contribute more than 99 percent of the original 2013 TRI TWPE for the Carbon Black Category (prior to corrections discussed below). Section 3.2.3 presents EPA's investigations of reported releases of this top pollutant. EPA did not investigate the other pollutants as part of the 2015 Annual Review because they represent a small percentage (approximately 0.01 percent) of the 2013 TRI TWPE for the Carbon Black Category.

Table 3-2. Carbon Black Category Top TRI Pollutants

	2013 TRI Data			2011 TRI Data	
Pollutant[a]	Number of Facilities Reporting Pollutant[b]	Original TWPE	Corrected TWPE	Number of Facilities Reporting Pollutant[b]	TWPE
PACs	3	63,800	38,500	3	27,900
Anthracene	1	4.57	4.57	1	2.79
Phenanthrene	1	0.522	0.522	1	0.319
Lead and Lead Compounds	2	0.259	0.259	3	0.517
Mercury and Mercury Compounds	1	0.012	0.012	1	0.012
Carbon Black Category Total[c]	**3**	**63,800**	**38,500**	**4**	**27,900**

Sources: *TRILTOutput2011_v1* (for 2011 TRI TWPE); *TRILTOutput2013_v1* (for 2013 TRI TWPE)
Note: Sums of individual values may not equal the total presented, due to rounding.
NA: Not applicable.
[a] Anthracene, phenanthrene, lead and lead compounds, and mercury and mercury compounds combined contribute less than 0.01 percent of the original 2013 category TRI TWPE. Therefore, EPA did not review any of these releases as part of the 2015 Annual Review.
[b] Number of facilities with TWPE greater than zero.
[c] The Carbon Black Category has water releases for only five pollutants in the 2013 TRI.

3.2.3 Carbon Black PAC Discharges in TRI

EPA's investigation of the PAC releases revealed that two facilities, GrafTech International Holdings, Inc. in Columbia, TN, and Cabot Corporation Canal Plant in Franklin, LA[15], account for 99 percent of the 2013 TRI PAC releases (shown in Table 3-3). Only three facilities have 2013 TRI PAC releases; the other is Cabot Corporation in Ville Platte, LA, which EPA did not investigate as part of the 2015 Annual Review because it contributes only 0.03 percent of the PAC TWPE in the Carbon Black Category.

Table 3-3. Top Facilities Reporting 2013 TRI PAC Releases

Facility Name	Facility Location	Pounds of Pollutant Released	Pollutant TWPE	Percent of Category TWPE
GrafTech International Holdings, Inc.	Columbia, TN	394	39,700	62.1%
Cabot Corporation Canal Plant	Franklin, LA	240	24,100	37.8%
Cabot Corporation Ville Platte Plant	Ville Platte, LA	0.16	16.1	0.03%
Total		**634**	**63,800**	**100%**

Source: *TRILTOutput2013_v1*
Note: Sums of individual values may not equal the total presented, due to rounding.

GrafTech International Holdings, Inc.

GrafTech International Holdings (GrafTech) in Columbia, TN, manufactures advanced graphite materials and refractory products. As part of its TRA data review and outlier correction process supporting the 2010, 2011, and 2013 Annual Reviews, EPA reviewed PAC releases from GrafTech. The corrections to the outlier data for this facility has historically dropped the category TWPE out of the top 95 percent (U.S. EPA, 2011, 2012, 2014). As discussed in the 2010 Annual Review Report, EPA contacted the facility to confirm PAC releases. The facility contact confirmed the PAC releases, provided sampling data, and explained that the facility estimates the release using the flow and the concentration of PACs in the total suspended solids (TSS) present in the wastewater (U.S. EPA, 2011).

In TRI, facilities report PAC releases as a class, not individual compounds. EPA estimates TWPE for PACs using the toxic weighting factor (TWF) for benzo(a)pyrene (100.66), the highest TWF associated with a PAC. Because the TWF for benzo(a)pyrene is higher than that for any other PAC, this represents a worst-case scenario. For PAC releases that are not composed completely of benzo(a)pyrene, this method overestimates the relative toxicity of the releases. Based on the monitoring data provided by the facility in 2010, EPA identified the specific PACs discharged and calculated a facility-specific TWF (Aslinger, 2010). As part of the TRA supporting the 2010, 2011, and 2013 Annual Reviews, EPA revised GrafTech's PAC releases to reflect their facility-specific TWF. Table 3-4 presents the original and corrected and TWPE used to support those annual reviews (U.S. EPA, 2011, 2012, 2014).

EPA contacted GrafTech as part of the 2015 Annual Review to confirm their 2013 discharges. The facility contact confirmed the 2013 PAC release and explained that the facility continues to estimate their PAC load by using the flow and process knowledge of the concentration of PACs in the TSS present in the wastewater. The facility contact also stated that

[15] Data sources list Cabot Corporation Canal Plant (TRI ID: 70583CBTCRSTATE, NPDES ID: LA000182) in either Franklin, LA or Centerville, LA. The cities are next to each other. The 2015 Annual Review Report lists the city as Franklin, LA because the company website lists the facility address at this location.

there was an increase in production from 2012 to 2013 (Philpot, 2015). Because the facility continues to calculate the PAC discharge using the same methods and monitoring data, EPA revised the 2013 releases to reflect the facility-specific TWF. Incorporating the facility-specific TWF decreases the 2013 PAC TWPE from 39,700 to 14,300.

Table 3-4. GrafTech PAC TRI Releases for 2008 – 2013

Year of Discharge	Original PAC Pounds Discharged	Original PAC TWPE	Corrected PAC TWPE
2008	1,090	110,000	8,950
2009	446	44,900	16,200
2011	371	37,300	13,500
2013	394	39,700	14,300

Source: U.S. EPA, 2011, U.S. EPA, 2012, U.S. EPA 2014, DMR Pollutant Loading Tool.

Cabot Corporation Canal Plant

Cabot Corporation Canal Plant (Cabot) in Franklin, LA, manufactures specialty chemicals and performance materials. As part of the 2015 Annual Review, EPA contacted the facility about its PAC releases. The facility contact explained that the facility estimates the PAC release based off the concentration of polycyclic aromatic hydrocarbons (PAHs) in the feedstock oil (removing anthracene and phenanthrene, which are not PACs) and the amount of wastewater used for the process. The facility adds in an estimate of solids based on process knowledge to reach a total amount of PACs discharged for the year (Longon, 2015). Although the facility uses process knowledge to determine the concentration of PACs in the feedstock oil, there is a potential for overestimation. Table 3-5 presents Cabot's PAC discharge data for the years 2007 through 2013. As shown, the discharges have fluctuated since 2007, with spikes in 2010 and 2013. The facility contact stated that an increase in production led to the increased discharges.

Table 3-5. Cabot PAC TRI Releases for 2007 – 2013

Year of Discharge	Pounds of PACs Released	PAC TWPE
2007	178	17,900
2008	168	16,900
2009	149	14,900
2010	233	23,500
2011	142	14,300
2012	147	14,800
2013	240	24,100

Source: DMR Loading Tool

3.2.4 Carbon Black Category Findings

The estimated toxicity of the Carbon Black Category discharges resulted primarily from PAC releases reported to TRI. From the 2015 Annual Review, EPA found:

- One facility, GrafTech International Holdings, Inc., in Columbia, TN, contributed 62 percent of the category's 2013 TRI PAC releases. EPA contacted the facility as part of the 2015 Annual Review; the facility confirmed the releases and estimation method. EPA revised the 2013 releases to reflect a facility-specific TWF to account for toxicity of specific the PACs discharged, which reduced the facility's TRI PAC TWPE from 39,700 to 14,300.

- One facility, Cabot Corporation Canal Plant, in Franklin, LA, contributed 38 percent of the category's 2013 TRI PAC releases. EPA contacted the facility as part of the 2015 Annual Review; the facility confirmed the release and explained that increases in production led to increased releases, however, the facility also indicated that the estimation methodology may overestimate PAC discharges.
- EPA identified that only two facilities accounted for 99 percent of the PAC TWPE for the Carbon Black Category. After applying a facility-specific TWF for GrafTech the 2013 Carbon Black Category TWPE decreased from 63,800 to 38,500. This change would drop the category outside the top 95 percent that EPA prioritized for preliminary review as part of the 2015 Annual Review.

3.2.5 Carbon Black Category References

1. Aslinger, Julia. 2010. Notes from E-mail Communication between Julia Aslinger, Center for Toxicology and Environmental Health, LLC, and Elizabeth Sabol, Eastern Research Group, Inc., Re: PAC Discharge Summary. (March 22). EPA-HQ-OW-2008-0517-0745.

2. ERG. 2015. Preliminary Category Review – Facility Data Review and Revised Calculations for Point Source Category – 458 – Carbon Black Manufacturing. (September). EPA-HQ-OW-2015-0665. DCN 08122.

3. Longon, Scott. 2015. Telephone Communication between Scott Longon, Cabot Corporation Canal Plant, and Kara Edquist, Eastern Research Group, Inc., Re: 2013 TRI PAC Discharges for Cabot Corporation's Canal Plant, Franklin, LA. (April 14). EPA-HQ-OW-2015-0665. DCN 08123.

4. Philpot, Beverley. 2015. Telephone Communication between Beverley Philpot, Graftech International Holdings, Inc., and Kara Edquist, Eastern Research Group, Inc., Re: 2013 TRI PAC Discharges for Graftech International Holdings, Inc., Columbia, TN. (April 14). EPA-HQ-OW-2015-0665. DCN 08124.

5. U.S. EPA. 2011. *Technical Support Document for the 2010 Effluent Guidelines Program Plan*. Washington, D.C. (October). EPA-820-R-10-021. EPA-HQ-OW-2008-0517-0618.

6. U.S. EPA. 2012. *The 2011 Annual Effluent Guidelines Review Report*. Washington, D.C. (December). EPA 821-R-12-001. EPA-HQ-OW-2010-0824-0195.

7. U.S. EPA. 2014. *The 2013 Annual Effluent Guidelines Review Report*. Washington, D.C. (September). EPA-821-R-14-003. EPA-HQ-OW-2014-0170-0077.

8. U.S. EPA. 2016. *Preliminary 2016 Effluent Guidelines Program Plan.* Washington, D.C. (June). EPA-821-R-16-001. EPA-HQ-OW-2015-0665. DCN 08208.

3.3 Grain Mills (40 CFR Part 406)

EPA identified the Grain Mills Category for preliminary review because it ranks high, in terms of toxic-weighted pound equivalents (TWPE), in the final 2015 combined point source category rankings. EPA has not completed a preliminary category review of the Grain Mills Category as part of recent annual reviews because it has not historically been a category that collectively contributed to the top 95 percent of the total TWPE in the point source category rankings. This section summarizes the results of the 2015 Annual Review. Hydrogen sulfide was added as a Toxic Release Inventory (TRI) reporting requirement in 2012. As a result, in 2013, hydrogen sulfide contributed a substantial amount of TWPE for the category. Therefore, for the 2015 Annual Review, EPA focused its review on discharges of hydrogen sulfide because of the high TWPE relative to the other pollutants discharged by facilities in the Grain Mills Category.

3.3.1 Grain Mills Category 2015 Toxicity Rankings Analysis

Table 3-6 compares the toxicity rankings analyses (TRA) data for the Grain Mills Category from the 2011, 2013, and 2015 Annual Reviews. EPA did not conduct the TRA in 2012 or 2014, but instead reviewed additional data sources as part of the even-year annual review, as described in Section 2.2.1 of EPA's Preliminary 2016 Plan (U.S. EPA, 2016). During the 2015 Annual Review, EPA did not identify any data corrections to the 2013 Discharge Monitoring Report (DMR) and TRI discharge data for the Grain Mills Category.

Table 3-6. Grain Mills Category TRI and DMR Facility Counts and Discharges Reported in 2009, 2011, and 2013

		Grain Mills Category Facility Counts[a]			Grain Mills Category TWPE		
Year of Discharge	Year of Review	Total TRI Facilities	Total DMR Major Facilities	Total DMR Minor Facilities	TRI TWPE[b]	DMR TWPE[c]	Total TWPE
2009	2011	32	10	13	6,190	2,900	9,090
2011	2013	23	7	18	10,500	2,810	13,300
2013	2015	31	5	15	179,000	22,300	201,000

Sources: *TRIReleases2009_v2*; *DMRLoads2009_v2* (for 2009 TRI and DMR); *TRILTOutput2011_v1*; *DMRLTOutput2011_v1* (for 2011 TRI and DMR); *TRILTOutput2013_v1*; *DMRLTOutput2013_v1* (for 2013 TRI and DMR).

Note: EPA did not evaluate 2010 or 2012 DMR and TRI data.

Note: TWPE values are rounded to three significant figures. Sums of individual values may not equal the total presented, due to rounding.

a Number of facilities with TWPE greater than zero.

b Releases include direct discharges to surface waters and transfers to POTWs. Transfers to POTWs account for POTW removals. The 2013 TRI TWPE also includes TWPE associated with reported releases of hydrogen sulfide. Facilities began reporting releases of hydrogen sulfide to TRI in 2012.

c Includes DMR discharges from both major and minor dischargers.

As shown in Table 3-6, the total TWPE increased slightly from 2009 to 2011 and substantially from 2011 to 2013. This substantial increase was driven by releases of hydrogen sulfide reported to TRI, discussed in the sections below. The number of facilities reporting to

TRI decreased from 2009 to 2011, but rose again in 2013. The total number of DMR facilities, both major and minor, declined slightly from 2009 to 2013.

3.3.2 Grain Mills Category Pollutants of Concern

EPA's 2015 review of the Grain Mills Category focused on the 2013 TRI releases because the TRI data dominate the category's combined TWPE. EPA did not focus on 2013 DMR discharges, however, the increase in DMR TWPE from 2011 to 2013 is attributed to an outlier flow during August 2013 from one facility, which was subsequently corrected in the source data after EPA finalized the 2015 combined point source category rankings. Table 3-7 shows the five pollutants with the highest contribution to the 2013 TRI TWPE. As a point of comparison, Table 3-7 also shows the 2011 TRI facility count and TWPE for these top pollutants, based on the 2013 Annual Review (U.S. EPA, 2014). Hydrogen sulfide contributes over 98 percent of the total 2013 TRI TWPE. Because hydrogen sulfide was added as a TRI reporting requirement in 2012, no hydrogen sulfide releases were reported in 2011. EPA's investigations of reported releases of hydrogen sulfide are presented in Sections 3.3.3 and 3.3.4. EPA did not investigate the other pollutants as part of the 2015 Annual Review, because they represent a small percentage (less than 2 percent) of the 2013 TRI TWPE for the Grain Mills Category.

Table 3-7. Grain Mills Category Top TRI Pollutants

Pollutant[a]	2013 TRI Data		2011 TRI Data	
	Number of Facilities Reporting Pollutant[b]	TWPE	Number of Facilities Reporting Pollutant[b]	TWPE
Hydrogen Sulfide	7	177,000	NA[c]	NA[c]
Nitrate Compounds	13	1,100	11	1,640
Ammonia	8	416	8	391
Ethylene Glycol	3	141	2	331
Lead and Lead Compounds	3	141	4	473
Top Pollutant Total	**NA**	**179,000**	**NA**	**2,840**
Grain Mills Category Total	**31**	**179,000**	**23**	**10,500**

Sources: *TRILTOutput2011_v1; TRILTOutput2013_v1.*
Note: Sums of individual values may not equal the total presented, due to rounding.
NA: Not applicable.
a Nitrate compounds, ammonia, ethylene glycol, and lead and lead compounds releases combined contribute less than 2 percent of the 2013 category TRI TWPE. Therefore, EPA did not review any of these releases as part of the 2015 Annual Review.
b Number of facilities with TWPE greater than zero.
c Hydrogen sulfide was added as a TRI reporting requirement in 2012 it was not a TRI-listed chemical in 2011.

3.3.3 Hydrogen Sulfide Background

As described in Section 2.2.2.1 of this report, facilities were required to report releases of hydrogen sulfide to TRI beginning in 2012. EPA did not perform a TRA in 2014; therefore, EPA is reviewing TRI reported hydrogen sulfide water releases for the first time as part of the 2015 Annual Review. Hydrogen sulfide is a biologically active compound that is found primarily as an anaerobic degradation product of both organic sulfur compounds and inorganic sulfates. Sulfides are constituents of many industrial wastes such as those from farming, food processors, tanneries, paper mills, chemical plants, and gas works. The anaerobic decomposition of sewage, sludge beds, algae, and other naturally deposited organic material is a major source of hydrogen sulfide (U.S. EPA, 1986). Discharges from these and other activities can release hydrogen sulfide to receiving waters (ATSDR, 2014).

Hydrogen sulfide is a soluble, colorless, highly poisonous, gaseous compound having the characteristic odor of rotten eggs. When soluble sulfides are added to water, they react with hydrogen ions to form the hydrosulfide ion (HS^-) and hydrogen sulfide (H_2S), the proportion of each depending on pH. The toxicity of sulfides derives primarily from hydrogen sulfide rather than from the hydrosulfide or sulfide ions. At pH 9, approximately 99 percent of the sulfide is in the form of HS^-; at pH 7 the sulfide is equally divided between HS^- and H_2S; and at pH 5 about 99 percent of the sulfide is present in the form of H_2S (U.S. EPA, 1986). In well aerated water, hydrogen sulfide is readily oxidized to sulfates and biologically oxidized to elemental sulfur. Under anaerobic conditions, microbial reduction of sulfate to sulfide can occur (WHO, 2003).

3.3.4 Grain Mills Category Hydrogen Sulfide Releases in TRI

EPA's investigation of the hydrogen sulfide data revealed that one facility, Cargill, Inc., Wet Corn Milling in Wahpeton, ND, accounts for over 98 percent of the hydrogen sulfide releases reported to TRI in 2013 (shown in Table 3-8). EPA did not investigate the remaining facilities reporting releases of hydrogen sulfide as part of the 2015 Annual Review.

Table 3-8. Top Facilities Reporting 2013 TRI Hydrogen Sulfide Releases

Facility Name	Facility Location	Pounds of Pollutant Released	Pollutant TWPE	Percent of Category TWPE
Cargill, Inc., Wet Corn Milling	Wahpeton, ND	62,500	175,000	98.8%
All other hydrogen sulfide releases in the Grain Mills Category[a]		776	2,170	1.2%
Total		**63,200**	**177,000**	**100%**

Source: *TRILTOutput2013_v1.*
Note: Sums of individual values may not equal the total presented, due to rounding.
[a] Six additional facilities reported hydrogen sulfide releases in the 2013 TRI.

Cargill, Inc., Wet Corn Milling in Wahpeton, ND, manufactures high fructose corn syrup. EPA contacted the facility as part of the 2015 Annual Review. The facility operates a wastewater treatment plant on site, which includes aerobic and anaerobic treatment steps, and discharges effluent from the wastewater treatment plant directly to the Red River. The hydrogen sulfide releases are produced by the anaerobic wastewater treatment at the facility, not directly by the manufacturing process (Razink, 2014). Sulfur compounds are not regulated pollutants in the Grain Mills effluent limitations guidelines and standards (ELGs) (40 CFR Part 406).

To estimate their 2013 TRI hydrogen sulfide release, the facility, over two weeks, took four direct samples of wastewater from their treatment plant's external outfall and measured the dissolved sulfide concentration in the samples. According to the facility, measurement of dissolved sulfide concentration in water may be a high bias estimate of hydrogen sulfide concentration. The average concentration from these four samples was multiplied by the average daily flow to estimate the pounds discharged per day, and then multiplied by the number of days wastewater was discharged in 2013 to estimate the annual pounds discharged (Razink, 2014). The facility reported similar direct releases of hydrogen sulfide to TRI in 2012 (184,000 TWPE) and 2013 (DMR Pollutant Loading Tool).

3.3.5 Grain Mills Category Findings

The estimated toxicity of the Grain Mills Category discharges resulted primarily from hydrogen sulfide releases reported to TRI. From the 2015 Annual Review, EPA found:

- One facility, Cargill, Inc., Wet Corn Milling in Wahpeton, ND, contributes over 98 percent of the category's 2013 TRI hydrogen sulfide releases. The facility has a NPDES permit for its wastewater treatment plant and is a direct discharger.
  - The reported direct release to TRI was estimated based on the average dissolved sulfide concentration from four samples taken over two weeks, and may reflects high bias releases of hydrogen sulfide from the facility.
  - The release may be attributed to anaerobic wastewater treatment at the facility, and not to the manufacturing process.
- Because the majority of the hydrogen sulfide releases are attributed to one facility, EPA does not consider them to be representative of the Grain Mills Category.

3.3.6 Grain Mills Category References

1. ATSDR. 2014. U.S. Department of Health and Human Services, Agency for Toxic Substances and Disease Registry. *Draft Toxicological Profile for Hydrogen Sulfide and Carbonyl Sulfide*. Atlanta, GA. (October). EPA-HQ-OW-2015-0665. DCN 08125.

2. ERG. 2015. Eastern Research Group, Inc. Preliminary Category Review – Facility Data Review for Point Source Category – 406 – Grain Mills. Chantilly, VA. (September). EPA-HQ-OW-2015-0665. DCN 08126.

3. Razink, Jonathan. 2014. Telephone and Email Communication Between Jonathan Razink, Cargill, Inc., and Kimberly Bartell, Eastern Research Group, Inc., Re: 2013 TRI Hydrogen Sulfide Releases. (December 22). EPA-HQ-OW-2015-0665. DCN 08127.

4. U.S. EPA. 1986. *Quality Criteria for Water*. Washington, D.C. (May). EPA-HQ-OW-2004-0032-2619.

5. U.S. EPA. 2014. *The 2013 Annual Effluent Guidelines Review Report*. Washington, D.C. (September). EPA-821-R-14-003. EPA-HQ-OW-2014-0170-0077.

6. U.S. EPA. 2016. *Preliminary 2016 Effluent Guidelines Program Plan.* Washington, D.C. (June). EPA-821-R-16-001. EPA-HQ-OW-2015-0665. DCN 08208.

7. WHO. 2003. World Health Organization. *Hydrogen Sulfide in Drinking-water*. EPA-HQ-OW-2015-0665. DCN 08128.

3.4 Iron and Steel Manufacturing (40 CFR Part 420)

EPA identified the Iron and Steel Manufacturing Category for preliminary review because it ranks high again, in terms of toxic-weighted pound equivalents (TWPE), in the final 2015 combined point source category rankings. Previously, EPA reviewed discharges from this category as part of the 2011 and 2013 Annual Reviews in which it also ranked high (U.S. EPA, 2012; U.S. EPA, 2014). This section summarizes the results of the 2015 Annual Review. EPA focused its 2015 review on discharges of polychlorinated biphenyls (PCBs), cyanide, fluoride, nitrate compounds, and lead and lead compounds due to their high TWPE relative to the other pollutants discharged by facilities in the Iron and Steel Manufacturing Category. Cyanide and fluoride, reviewed as part of the 2013 Annual Review, continue to be top pollutants of concern. For the 2015 Annual Review, available discharge data also showed significant contributions of PCBs, nitrate compounds, and lead and lead compounds. For further background on the Iron and Steel Manufacturing Category, including an industry profile, see *The 2011 Annual Effluent Guidelines Review Report* (U.S. EPA, 2012).

3.4.1 Iron and Steel Manufacturing Category 2015 Toxicity Rankings Analysis

Table 3-9 compares the toxicity rankings analyses (TRA) data for the Iron and Steel Manufacturing Category from the 2011, 2013, and 2015 Annual Reviews. EPA did not conduct the TRA in 2012 or 2014, but instead reviewed additional data sources as part of the even-year annual review, as described in Section 2.2.1 of EPA's Preliminary 2016 Plan (U.S. EPA, 2016). As discussed in this section, during the 2015 Annual Review, EPA identified data corrections that affected the 2013 Discharge Monitoring Report (DMR) and Toxic Release Inventory (TRI) data and TWPE. The bottom row of Table 3-9 shows the corrected data resulting from this review.

Table 3-9. Iron and Steel Manufacturing Category TRI and DMR Facility Counts and Discharges Reported in 2009, 2011, and 2013

Year of Discharge	Year of Review	Iron and Steel Manufacturing Category Facility Counts[a]			Iron and Steel Manufacturing Category TWPE		
		Total TRI Facilities	Total DMR Major Facilities	Total DMR Minor Facilities	TRI TWPE[b]	DMR TWPE[c]	Total TWPE
2009	2011	227	73	49	96,200	108,000[d]	205,000[d]
2011	2013	222	76	45	82,900	214,000[e]	297,000[e]
2013	2015	215	51	29	84,600[f]	188,000[f]	273,000[f]
					82,600[g]	182,000[g]	264,000[g]

Sources: 2013 Annual Review Report (for 2009 and 2011 DMR and TRI Data) (U.S. EPA, 2014); *DMRLTOutput2013_v1* (for 2013 DMR); *TRILTOutput2013_v1* (for 2013 TRI).
Note: EPA did not evaluate 2010 or 2012 DMR and TRI data.
Note: TWPE values are rounded to three significant figures. Sums of individual values may not equal the total presented, due to rounding.
a Number of facilities with TWPE greater than zero.
b Releases include direct discharges to surface waters and transfers to POTWs. Transfers to POTWs account for POTW removals.
c Includes DMR data from both major and minor dischargers.
d 2009 data after corrections were made during the 2011 Annual Review.
e 2011 data after corrections were made during the 2013 Annual Review.
f 2013 data prior to corrections made during the 2015 Annual Review.
g 2013 data after corrections were made during the 2015 Annual Review.

As shown in Table 3-9, the number of TRI facilities with pollutant releases and TRI TWPE decreased from 2009 to 2013. The number of permitted facilities with DMR data also decreased from 2009 to 2013. This suggests that the number of U.S. iron and steel facilities may be declining. However, during the same timeframe, the DMR TWPE increased substantially from 2009 to 2011, then decreased from 2011 to 2013.

3.4.2 Iron and Steel Manufacturing Category Pollutants of Concern

EPA's 2015 review of the Iron and Steel Manufacturing Category focused on the 2013 DMR and TRI discharges because both contribute to the category's combined TWPE. Table 3-10 shows the five pollutants with the highest contribution to the 2013 DMR TWPE. Table 3-10 also presents the 2013 DMR TWPE after EPA corrected errors identified in this preliminary category review (discussed in the sections below). As a point of comparison, Table 3-10 also shows the 2011 DMR facility count and TWPE for these top five pollutants, based on the 2013 Annual Review (U.S. EPA, 2014). PCBs, cyanide, and fluoride contribute over 70 percent of the original 2013 DMR TWPE for the Iron and Steel Manufacturing Category (prior to corrections discussed below). Additionally, EPA investigated DMR discharges of lead because it is a top TRI pollutant. Of these top pollutants, only cyanide and lead are regulated pollutants in the Iron and Steel Category effluent limitations guidelines and standards (ELGs) (40 CFR Part 420). Sections 3.4.3 through 3.4.6 present EPA's investigation of DMR discharges of PCBs, cyanide, fluoride, and DMR and TRI-reported discharges of lead. EPA did not investigate total residual chlorine as part of the 2015 Annual Review because it represents a small percentage (7 percent) of the 2013 DMR TWPE for the Iron and Steel Manufacturing Category.

Table 3-11 shows the five pollutants with the highest contribution to the 2013 TRI TWPE. Table 3-11 also presents the 2013 TRI TWPE after EPA corrected errors identified in this preliminary category review (discussed in the sections below). As a point of comparison, Table 3-11 also shows the 2011 TRI facility count and TWPE for these top five pollutants, based on the 2013 Annual Review (U.S. EPA, 2014). Nitrate compounds and lead and lead compounds contribute over 56 percent of the original 2013 TRI TWPE for the Iron and Steel Manufacturing Category (prior to corrections discussed below). Sections 3.4.6 and 3.4.7 present EPA's investigation of reported TRI releases of lead and lead compounds and nitrate compounds. EPA did not conduct a facility-level investigation of polycyclic aromatic compounds, manganese and manganese compounds, and copper and copper compounds, as part of the 2015 Annual Review because they contribute a small amount of TWPE relative to the other top pollutants in the Iron and Steel Manufacturing Category. However, many facilities report manganese and manganese compound and copper and copper compound releases to TRI, as shown in Table 3-11.

Table 3-10. Iron and Steel Manufacturing Category Top DMR Pollutants

Pollutant[b]	2013 DMR Data[a]			2011 DMR Data[a]	
	Number of Facilities Reporting Pollutant[c]	Original TWPE	Corrected TWPE	Number of Facilities Reporting Pollutant[c]	TWPE[d]
PCBs	1	76,700	76,700	1	73,200
Cyanide	13	29,200	22,700	26	34,100
Fluoride	10	26,500	26,500	17	34,200
Total Residual Chlorine	20	13,700	13,700	29	28,600
Lead	33	8,760	8,760	63	12,600
Top Pollutant Total	**NA**	**155,000**	**148,000**	**NA**	**110,000**
Iron and Steel Manufacturing Category Total	**80**	**188,000**	**182,000**	**121**	**214,000**

Sources: *DMRLTOutput2013_v1* (for 2013 TWPE); *DMRLTOutput2011_v1* (for 2011 facility counts); 2013 Annual Review Report (for 2011 TWPE) (U.S. EPA, 2014).
Note: Sums of individual values may not equal the total presented, due to rounding.
NA: Not applicable

a Includes DMR data from both major and minor dischargers.
b Total residual chlorine discharges contribute 7 percent of the original 2013 category DMR TWPE. Therefore, EPA did not review total residual chlorine discharges as part of the 2015 Annual Review.
c Number of facilities with TWPE greater than zero.
d 2011 data after corrections were made during the 2013 Annual Review.

Table 3-11. Iron and Steel Manufacturing Category Top TRI Pollutants

	2013 TRI Data			2011 TRI Data	
Pollutant[a]	Number of Facilities Reporting Pollutant[b]	Original TWPE	Corrected TWPE	Number of Facilities Reporting Pollutant[b]	TWPE
Nitrate Compounds	56	25,400	25,400	55	24,600
Lead and Lead Compounds	133	22,700	20,600[c]	135	24,300
Polycyclic Aromatic Compounds	5	6,910	6,910	4	11,400
Manganese and Manganese Compounds	114	5,680	5,680	117	6,250
Copper and Copper Compounds	79	4,990	4,990	78	4,270
Top Pollutant Total	**NA**	**65,700**	**63,600**	**NA**	**70,800**
Iron and Steel Manufacturing Category Total	**215**	**84,600**	**82,600**	**222**	**82,900**

Sources: *TRILTOutput2011_v1* (for 2011 TRI TWPE); *TRILTOutput2013_v1* (for 2013 TRI TWPE)
Note: Sums of individual values may not equal the total presented, due to rounding.
NA: Not applicable.

[a] Polycyclic aromatic compounds, manganese and manganese compounds, and copper and copper compounds each contribute less than 9 percent of the original 2013 category TRI TWPE. Therefore, EPA did not review polycyclic aromatic compound, manganese and manganese compound, or copper and copper compound releases as part of the 2015 Annual Review.

[b] Number of facilities with TWPE greater than zero.

[c] EPA identified two facilities with revisions to their 2013 TRI lead and lead compound releases. Section 3.4.6 discusses the correction from Charter Steel Cleveland. EPA also received corrected data from ArcelorMittal Burns Harbor LLC in Burns Harbor, IN (Bley, 2015). EPA revised the 2013 TRI lead and lead compound TWPE to incorporate the corrected data from these facilities.

3.4.3 Iron and Steel Manufacturing PCBs Discharges in DMR

EPA's investigation of the PCB discharges revealed that one facility, U.S. Steel Fairless Hills Works, in Fairless Hills, PA, accounts for 100 percent of the 2013 DMR PCB discharges. In 2013, the facility reported 2.25 pounds of PCBs discharged, corresponding to 76,700 TWPE (*DMRLTOutput2013_v1)*. EPA did not review 2011 PCB discharges from this facility as part of its 2013 Annual Review because the facility submitted 2011 PCB DMR data after EPA compiled the *DMRLTOutput2011_v1* database supporting the 2013 Annual Review.

As part of the 2015 Annual Review, EPA contacted U.S. Steel about the Fairless Hills facility. The facility began operation in 1952 and was a fully integrated steel mill. The facility included two blast furnaces, nine open-hearth furnaces, two coke batteries, an 80-inch hot strip mill, rolling mills, a sheet and tin department, hot dip galvanizing line, a pipe mill, and a deep-water vessel slip. The entire facility was located on nearly 4,000 acres along the Delaware River. At the time of construction and operation of the facility, PCBs were common in electrical equipment at the facility (Lasko, 2015).

In August 1991, the company closed and systematically demolished the pipe mill and the hot side of the plant, which included iron making, steel making, cokemaking, and hot rolling productions. In 1998, the remaining cold finishing operations, excluding the hot dip galvanizing line, were permanently idled. The company has substantially redeveloped the site but several buildings remain in the sheet and tin area (Lasko, 2015).

Table 3-12 presents U.S. Steel Fairless Hills Works' PCB discharges for 2011 through 2014. As shown, the PCB discharges have remained consistent from 2011 through 2013, and decreased in 2014. U.S. Steel does not know the source of the PCBs detected in discharges from the Fairless Hills Works' facility; however, they have confirmed that the PCBs are not associated with the remaining hot dip galvanizing line. Therefore, the facility has attributed the discharges to historical production activities at the site (Lasko, 2015).

Table 3-12. U.S. Steel Fairless Hills Works' PCB Discharges for 2011-2014

Year	PCB TWPE
2011	73,200
2012	69,800
2013	76,700
2014	25,800

Source: *DMRLTOutput2013_v1;* DMR Loading Pollutant Tool (Loading Tool).

In 2003, EPA Regions 2 and 3 adopted a Total Maximum Daily Load (TMDL) for PCBs for Zones 2, 3, 4, and 5 of the tidal Delaware River. This change required U.S. Steel to perform PCB analyses on wastewater discharges using EPA Method 1668A. This wastewater sampling and analysis has narrowed the location of the potential sources of PCB discharges to the lower segment of the facility, near outfall 002. U.S. Steel is currently working with the Delaware River Basin Commission (DRBC) to investigate further this segment of the canal to determine the source of the PCB discharges (Lasko, 2015). The facility's PCB discharges have decreased from 2013 to 2014, as shown in Table 3-12, and the PCB discharges are associated with historical production activities, not current operations. Additionally, the company is working with DRBC to determine the source of the PCB discharges.

3.4.4 Iron and Steel Manufacturing Cyanide Discharges in DMR

EPA's investigation of the cyanide discharges revealed that two facilities, Mountain State Carbon, LLC[16], in Follansbee, WV, and U.S. Steel Clairton Plant, Clairton, PA, account for 76 percent of the 2013 cyanide discharges (shown in Table 3-13). EPA reviewed cyanide discharges from both of these facilities as part of the 2011 and 2013 Annual Reviews (U.S. EPA, 2012, U.S. EPA, 2014). EPA did not investigate the remaining 11 facilities discharging cyanide as part of the 2015 Annual Review.

[16] This facility is named Severstal Wheeling, Inc. in the DMR database (*DMRLTOutput2013_v1*). However, the facility's permit lists the permittee as Mountain State Carbon, LLC.

Table 3-13. Top 2013 DMR Cyanide Discharging Facilities

Facility Name	Facility Location	Pounds of Pollutant Discharged	Pollutant TWPE	Percent of Category TWPE
Mountain State Carbon, LLC	Follansbee, WV	10,900	12,100	41.4%
U.S. Steel Clairton Plant	Clairton, PA	9,050	10,000	34.4%
All other cyanide dischargers in the Iron and Steel Manufacturing Category[a]		6,390	7,090	24.2%
Total		**26,300**	**29,200**	**100%**

Source: *DMRLTOutput2013_v1.*
Note: Sums of individual values may not equal the total presented, due to rounding.
[a] Eleven additional facilities submitted cyanide discharges in the 2013 DMR data.

Both of the top two facilities are cokemaking plants, i.e., they produce carbon-coke from coal for use in steelmaking. Cokemaking operations generate wastewater containing cyanide during the byproduct recovery process. For further information on cokemaking plants in the U.S., see Section 9.4 of the 2011 Annual Review Report (U.S. EPA, 2012).

During the 2002 Iron and Steel rulemaking, EPA established production-based limits for cyanide based on the performance of best available technology (BAT) for the cokemaking subcategory (40 CFR Part 420 Subpart A). The BAT production-based limits are based on a long-term average (LTA) of 2.965 mg/L, and a variability factor of 1.49 (U.S. EPA, 2002, Appendices D and E).

Mountain State Carbon

Mountain State Carbon, LLC, in Follansbee, WV, discharges cyanide from two outfalls. EPA reviewed cyanide discharges from this facility as part of the 2011 and 2013 Annual Reviews. As part of the 2015 Annual Review, EPA contacted the facility and learned they received a revised permit, becoming effective on October 1, 2013. The new permit changed the naming of the outfalls; outfall 205 was renamed outfall 006 and outfall 005 was renamed outfall 004. Mountain State Carbon has discharges and separate permit limits for total cyanide and weak acid dissociable cyanide (CNWAD).[17] Table 3-14 presents the 2008 and 2013 permit limits for Mountain State Carbon for total cyanide and CNWAD (Smith, 2015).

Table 3-14. Mountain State Carbon 2008 and 2013 Permit Limits

Outfall Number	Total Cyanide Monthly Average Permit Limit	Total Cyanide Daily Maximum Permit Limit	CNWAD Monthly Average Permit Limit	CNWAD Daily Maximum Permit Limit
2008 Permit Limits				
005	None	None	0.0114 mg/L	0.0284 mg/L

[17] Because a permit may require a facility to measure a pollutant in more than one way, such as discharges of total cyanide and CNWAD, EPA groups the DMR data using a hierarchy to determine which parameter best represents the total pollutant discharges. This avoids double counting of discharges. For this reason, EPA grouped total cyanide and CNWAD discharges under DMR cyanide discharges. See Section 3.2.3.2 of the *Technical Support Document for the Annual Review of Existing Effluent Guidelines and Identification of Potential New Point Source Categories* (2009 Screening-Level Analysis (SLA) Report) for more information on pollutant groupings in DMR (U.S. EPA, 2009).

Table 3-14. Mountain State Carbon 2008 and 2013 Permit Limits

Outfall Number	Total Cyanide Monthly Average Permit Limit	Total Cyanide Daily Maximum Permit Limit	CNWAD Monthly Average Permit Limit	CNWAD Daily Maximum Permit Limit
205	24.5 lb/day (11.1 kg/day)	34.9 lb/day (15.8 kg/day)	None	None
2013 Permit Limits				
004 (previously 005)	Report Only	Report Only	Report Only	Report Only
006 (previously 205)	25.6 lb/day (11.6 kg/day) or 4.39 mg/L	36.6 lb/day (16.6 kg/day) or 9.31 mg/L	0.067 mg/L	0.12 mg/L

Source: WVDEP, 2008a; WVDEP, 2013b

The change in outfall designations mid-way through 2013 caused the Loading Tool to calculate facility discharge loads inaccurately. The Loading Tool calculates pollutant loadings from DMR data submitted by the facility. For months when a facility reports no flow and concentration data, the Loading Tool calculates estimated monthly discharges.[18] In this instance, the Loading Tool interpreted the new outfall numbers as representing two new outfalls, and assigned both "new" outfalls estimated monthly discharges (for months that had data missing), while continuing to apply estimated discharges to the old outfall numbers. As a result, cyanide discharges from this facility were, at first, substantially overestimated. EPA corrected this error, resulting in a decrease of the facility's cyanide TWPE from 12,100 to 5,570.

Table 3-15 presents Mountain State Carbon's 2013 DMR CNWAD discharges and NPDES monthly average permit limit for outfall 004 (previously outfall 005). Table 3-16 presents Mountain State Carbon's 2013 DMR total cyanide discharges and NPDES monthly average permit limit for outfall 006 (previously outfall 205). As shown in Table 3-15, the CNWAD discharges for outfall 004 (previously outfall 005) are below permit limits. However, as shown in Table 3-16, the May 2013 quantity from outfall 006 (previously outfall 205) and the November 2013 concentration from outfall 006 exceed the facility permit limits.

Table 3-15. Mountain State Carbon's 2013 DMR CNWAD Discharges

Outfall	Date	Reported Monthly Average Flow (MGD)	Reported Monthly Average Concentration (mg/L)	NPDES Monthly Average Permit Limit
005	31-Jan-13	7.58	0.0021	0.0114 mg/L
005	28-Feb-13	6.52	0.0021	0.0114 mg/L
005	31-Mar-13	13.5	0.0026	0.0114 mg/L
005	30-Apr-13	14.3	0.0016	0.0114 mg/L
005	31-May-13	13.5	0.0026	0.0114 mg/L
005	30-Jun-13	12.6	0.0009	0.0114 mg/L
005	31-Jul-13	9.39	0.0029	0.0114 mg/L

[18] For example, Mountain State Carbon's 2013 permit renamed outfall 205 as 006; the two numbers represent the same outfall. Mountain State Carbon submitted nine months of concentration and flow data for outfall 205, and three months of concentration and flow data for the same outfall after its number was changed from 205 to 006. For outfall 205, the DMR Loading Tool calculated the total load for the year and estimated discharges for the three "missing" months. For outfall 006, the DMR Loading Tool calculated the total load for the year and estimated discharges for nine "missing months."

Table 3-15. Mountain State Carbon's 2013 DMR CNWAD Discharges

Outfall	Date	Reported Monthly Average Flow (MGD)	Reported Monthly Average Concentration (mg/L)	NPDES Monthly Average Permit Limit
005	31-Aug-13	8.68	0.0020	0.0114 mg/L
005	30-Sep-13	10.0	0.0021	0.0114 mg/L
004[a]	31-Dec-13	13.2	0.013	Report Only

Sources: *DMRLTOutput2013_v1*; Smith, 2015; WVDEP, 2008a; WVDEP, 2013b

[a] The revised permit changed the monitoring requirement for this outfall from monthly to quarterly, therefore, after September 2013, the facility only submitted CNWAD discharges for the outfall in December 2013.

Table 3-16. Mountain State Carbon's 2013 DMR Total Cyanide Discharges

Outfall	Date	Reported Monthly Average Flow (MGD)	Reported Monthly Average Concentration (mg/L)	Reported Monthly Average Quantity (lb/d)	NPDES Monthly Average Permit Limit
205	31-Jan-13	0.57	NR	9.68	24.5 lb/d
205	28-Feb-13	0.6	NR	9.19	24.5 lb/d
205	31-Mar-13	0.58	NR	8.29	24.5 lb/d
205	30-Apr-13	0.59	NR	12.0	24.5 lb/d
205	31-May-13	0.5	NR	27.8[a]	24.5 lb/d
205	30-Jun-13	0.69	NR	14.0	24.5 lb/d
205	31-Jul-13	0.73	NR	8.29	24.5 lb/d
205	31-Aug-13	0.65	NR	11.0	24.5 lb/d
205	30-Sep-13	0.7	NR	8.90	24.5 lb/d
006	31-Oct-13	0.578	3.4	NR	4.39 mg/L
006	30-Nov-13	0.606	4.5[a]	NR	4.39 mg/L
006	31-Dec-13	0.6	2.1	NR	4.39 mg/L

Sources: *DMRLTOutput2013_v1*; Smith, 2015; WVDEP, 2008a; WVDEP, 2013b

NR: Not Reported

[a] Cyanide concentration or quantity exceeds monthly average permit limit.

U.S. Steel Clairton Plant

U.S. Steel Clairton Plant discharges cyanide in cokemaking wastewater from outfall 183. EPA reviewed this facility's cyanide discharges as part of the 2011 and 2013 Annual Reviews. As part of the 2015 Annual Review, EPA contacted U.S. Steel to discuss the Clairton Plant's cyanide discharges. The facility received a revised permit in May 2012 that included revised cyanide permit limits. The facility appealed the revised cyanide permit limits and settled with the Pennsylvania Department of Environmental Protection (PA DEP) with a consent order in January 2014. PA DEP reissued the permit, which became effective in February 2015 (Lasko, 2015). Table 3-17 presents the facility's 2002, 2012, and 2015 cyanide permit limits for outfall 183.

Table 3-17. U.S. Steel Clairton Plant's 2002, 2012, and 2015 Cyanide Permit Limits for Outfall 183

Permit	Cyanide Monthly Average Permit Limit (mg/L)	Cyanide Monthly Average Permit Limit (lb/day)	Cyanide Daily Maximum Permit Limit (mg/L)	Cyanide Daily Maximum Permit Limit (lb/day)

Table 3-17. U.S. Steel Clairton Plant's 2002, 2012, and 2015 Cyanide Permit Limits for Outfall 183

2002 Permit Limits	5.5	118	10	216
2012 Permit Limits	4.41	90.5	6.30	129
2015 Permit Limits	5.5	94	10	134

Source: PA DEP, 2002, PA DEP, 2012, PA DEP, 2015

PA DEP extended the 2002 cyanide permit limits for outfall 183 until the revised 2012 permit became effective. However, because the facility appealed the cyanide permit limits in the revised 2012 permit, the facility had to meet the 2002 cyanide permit limits in 2013. Table 3-18 presents U.S. Steel's 2013 monthly cyanide and flow discharge data for outfall 183. EPA calculated the cyanide concentrations using the reported quantity and average monthly flows. As shown, the facility's discharge concentrations do not exceed the 2002, 2012, or 2015 permit limits and are below the LTA for cyanide calculated for the 2002 rulemaking (2.965 mg/L). The facility's high cyanide TWPE is likely the result of the large amount of industrial activity at the site. This facility has historically been the top coke producer in the U.S. (U.S. EPA, 2002).

Table 3-18. U.S. Steel Clairton Plant's 2013 DMR Cyanide Discharges for Outfall 183

Date	Reported Monthly Average Flow (MGD)	Reported Monthly Average Quantity (kg/d)	Calculated Monthly Average Concentration (mg/L)
31-Jan-13	2.4	7.27	0.800
28-Feb-13	2.49	9.18	0.974
31-Mar-13	2.34	14.2	1.60
30-Apr-13	2.43	16.7	1.82
31-May-13	2.38	9.38	1.04
30-Jun-13	2.41	7.66	0.840
31-Jul-13	2.59	10.1	1.03
31-Aug-13	2.44	20.3	2.20
30-Sep-13	2.4	11.3	1.24
31-Oct-13	2.37	10.3	1.15
30-Nov-13	2.45	10.2	1.10
31-Dec-13	2.48	7.61	0.811

Sources: *DMRLTOutput2013_v1*

3.4.5 Iron and Steel Manufacturing Fluoride Discharges in DMR

EPA's investigation of the fluoride discharges revealed that four facilities, account for 94 percent of the reported 2013 fluoride discharges (shown in Table 3-19). EPA did not investigate the remaining six facilities discharging fluoride as part of the 2015 Annual Review.

Table 3-19. Top 2013 DMR Fluoride Discharging Facilities

Facility Name	Facility Location	Pounds of Pollutant Discharged	Pollutant TWPE	Percent of Category TWPE
U.S. Steel Gary Works[a]	Gary, IN	324,000	9,730	36.7%
ArcelorMittal Weirton LLC[b]	Weirton, WV	240,000	7,190	27.1%
U.S. Steel Granite City Works	Granite City, IL	154,000	4,620	17.4%
ArcelorMittal Burns Harbor LLC	Burns Harbor, IN	114,000	3,410	12.9%
All other fluoride dischargers in the Iron and Steel Manufacturing Category[c]		53,100	1,590	6.00%
Total		**885,000**	**26,500**	**100%**

Source: *DMRLTOutput2013_v1*.
Note: Sums of individual values may not equal the total presented, due to rounding.
[a] This facility is named USS Gary Works in the DMR database (*DMRLTOutput2013_v1*) and in the 2013 Annual Review Report (U.S. EPA, 2014). However, the facility's permit lists the permittee as U.S. Steel Gary Works.
[b] This facility is named Mittal Steel USA Weirton Inc. in the DMR database (*DMRLTOutput2013_v1*) and Weirton Steel Corporation in the 2013 Annual Review Report (U.S. EPA, 2014). However, the facility's permit lists the permittee as ArcelorMittal Weirton LLC.
[c] Six additional facilities submitted fluoride discharges in the 2013 DMR data.

The Iron and Steel Manufacturing Category ELGs do not include discharge limits for fluoride. During previous annual reviews, EPA researched treatment technologies that were capable of removing fluoride (not specific to iron and steel wastewater discharges) and found they achieve effluent fluoride concentrations between 2 mg/L and 15 mg/L (WC&E, 2006; Ionics, n.d.; GCIP, 2002). EPA used these effluent fluoride concentrations as benchmarks for initial comparison of fluoride discharges from iron and steel manufacturing facilities.

U.S. Steel Gary Works

U.S. Steel Gary Works in Gary, IN, discharges fluoride into the Grand Calumet River from outfalls 005, 028, and 030 (IDEM, 2014). EPA previously reviewed fluoride discharges from this facility as part of the 2013 Annual Review. Outfall 005 discharges cooling water and condensate from many operations along with stormwater runoff. Outfalls 028 and 030 are discharges from lagoons that collect continuous caster non-contact cooling water, cooling tower blowdown, stormwater runoff, steam condensate, and slab spray cooling water. The facility's permit requires monitoring fluoride in discharges from outfalls 005, 028, and 030, but does not include fluoride limits (IDEM, 2014).

Table 3-20 presents U.S. Steel Gary Works' fluoride discharge data for 2013. EPA calculated the fluoride concentrations using the quantity and average monthly flows. The fluoride concentrations range from 0.306 mg/L to 4.01 mg/L. Table 3-21 also presents the facility's fluoride discharges for 2011 through 2014. As shown, discharges were nearly unchanged from 2011 to 2012, but decreased steadily from 2012 to 2014. Similar to the 2013 Annual Review, EPA found that fluoride concentrations for U.S. Steel Gary Works fall at the low end of the range of concentrations achievable by current technologies described above.

Table 3-20. U.S. Steel Gary Works' 2013 DMR Fluoride Discharges

Outfall	Date	Reported Monthly Average Flow (MGD)	Reported Monthly Average Quantity (kg/d)	Calculated Monthly Average Concentration (mg/L)
005	31-Jan-13	38.8	84.3	0.574
005	28-Feb-13	41.4	77.1	0.492
005	31-Mar-13	41.7	86.6	0.549
005	30-Apr-13	42.6	86.1	0.534
005	31-May-13	41.4	66.6	0.425
005	30-Jun-13	44.7	68.4	0.404
005	31-Jul-13	45.3	72.1	0.421
005	31-Aug-13	47.5	71.2	0.396
005	30-Sep-13	47.7	62.1	0.344
005	31-Oct-13	43.7	67.1	0.406
005	30-Nov-13	46.2	53.5	0.306
005	31-Dec-13	52.4	62.5	0.315
028	31-Jan-13	8.6	105	3.23
028	28-Feb-13	7.2	86.6	3.18
028	31-Mar-13	7.1	86.1	3.20
028	30-Apr-13	7.1	74.3	2.76
028	31-May-13	8.4	87.5	2.75
028	30-Jun-13	8.1	105	3.42
028	31-Jul-13	8.2	109	3.51
028	31-Aug-13	8.6	103	3.16
028	30-Sep-13	9.2	119	3.42
028	31-Oct-13	7.6	82.9	2.88
028	30-Nov-13	8.4	92.1	2.90
028	31-Dec-13	7.9	120	4.01
030	31-Jan-13	20.5	249	3.21
030	28-Feb-13	20.2	251	3.28
030	31-Mar-13	18.6	234	3.33
030	30-Apr-13	18.7	205	2.90
030	31-May-13	20.9	224	2.83
030	30-Jun-13	18.7	228	3.23
030	31-Jul-13	19.0	265	3.69
030	31-Aug-13	19.4	245	3.34
030	30-Sep-13	19.4	257	3.51
030	31-Oct-13	14.1	163	3.06
030	30-Nov-13	17.4	224	3.40
030	31-Dec-13	18	264	3.87

Source: *DMRLTOutput2013_v1*

Table 3-21. U.S. Steel Gary Works' Fluoride Discharges for 2011 – 2014

Year	Pounds of Fluoride Discharged	Fluoride TWPE
2011	339,000	10,200
2012	346,000	10,400
2013	324,000	9,730
2014	293,000	8,800

Source: *DMRLTOutput2013_v1;* DMR Loading Tool.

ArcelorMittal Weirton LLC

ArcelorMittal Weirton LLC in Weirton, WV, discharges fluoride from outfalls 003 and 004 into the Ohio River and Harmon Creek, respectively. The facility discharges cooling water, stormwater runoff, and process wastewater from outfall 003, and untreated stormwater through outfall 004. EPA previously reviewed fluoride discharges from this facility as part of the 2013 Annual Review. The facility's 2008 permit calls for monitoring of fluoride discharges from outfall 003, but does not include fluoride limits. The fluoride permit limit for outfall 004 is 1.4 mg/L monthly average and 2.2 mg/L daily maximum (WVDEP, 2008b).

Table 3-22 presents the facility's fluoride discharge data for 2013. As described above, EPA determined that current wastewater technologies (not specific to iron and steel) are achieving effluent fluoride concentrations between 2 mg/L and 15 mg/L. EPA determined that 2013 fluoride concentrations from outfall 004, shown in Table 3-22 are below the facility's permit limit and below concentrations achievable by current technologies. However, the fluoride concentrations from outfall 003 are substantially higher than outfall 004, by an order of magnitude. Table 3-23 presents the facility's fluoride discharges for 2011 through 2014. As shown, discharges have remained consistent from 2011 through 2013, and have decreased from 2013 to 2014.

The facility received a revised permit, effective May 2014. This permit includes fluoride limits for outfall 003 of 4.3 mg/L monthly average and 5.9 mg/L daily maximum, effective May 1, 2017, based on water quality standards (WVDEP, 2014; WVDEP, 2013a). As the facility comes into compliance with the new permit limits, EPA expects that fluoride discharges from ArcelorMittal Weirton LLC will decrease in future DMRs.

Table 3-22. ArcelorMittal Weirton LLC's 2013 DMR Fluoride Discharges

Outfall	Date	Reported Monthly Average Flow (MGD)	Reported Monthly Average Concentration (mg/L)
003	31-Jan-13	10.3	8.05
003	31-Mar-13	10.9	6.38
003	30-Jun-13	11.7	9.1
003	31-Dec-13	7.3	7.51
004	31-Jan-13	0.77	0.27
004	28-Feb-13	0.82	0.25
004	31-Mar-13	0.66	0.28
004	30-Apr-13	1.28	0.3
004	31-May-13	0.6	0.3
004	30-Jun-13	0.7	0.3
004	31-Jul-13	1.6	0.3
004	31-Aug-13	0.6	0.4
004	30-Sep-13	0.7	0.4
004	31-Oct-13	0.7	0.4
004	30-Nov-13	0.7	0.4
004	31-Dec-13	0.8	0.4

Source: *DMRLTOutput2013_v1*

Table 3-23. ArcelorMittal Weirton LLC's Fluoride Discharges for 2011 – 2014

Year	Pounds of Fluoride Discharged	Fluoride TWPE
2011	331,000	9,940
2012	357,000	10,700
2013	240,000	7,190
2014	216,000	6,490

Source: *DMRLTOutput2013_v1;* DMR Loading Tool.

U.S. Steel Granite City Works

U.S. Steel Granite City Works, in Granite City, IL, discharges fluoride from outfall 001 to Horseshoe Lake. Discharges consist of wastewater from numerous sources, including the blast furnace, the hot strip mill, the galvanizing lines, continuous casters, maintenance shops, laboratories, the coke plant, the cold mill, and the continuous pickler. Discharges also contain landfill leachates, sanitary, stormwater runoff, and boiler blowdown. EPA has not previously reviewed fluoride discharges from this facility. The facility received a revised permit, effective June 1, 2015. The fluoride limits were not revised, but continue to include a 4 mg/L (834 lb/day) daily maximum limit for fluoride from outfall 001, with no monthly average fluoride limits (ILEPA, 2015).

Table 3-24 presents the facility's fluoride discharge data for 2013. EPA calculated the fluoride concentrations using the reported quantities and average monthly flows. The fluoride concentrations range from 2.17 mg/L to 4.49 mg/L. EPA determined that fluoride concentrations for U.S. Steel Granite City Works are generally below those achievable by current technologies, described above. However, the June and July 2013 monthly average fluoride concentrations exceed the daily maximum permit limit. Table 3-25 presents the facility's fluoride discharges for 2011 through 2014. As shown, discharge levels decreased from 2011 to 2014.

Table 3-24. U.S. Steel Granite City Works' 2013 DMR Fluoride Discharges for Outfall 001

Date	Reported Monthly Average Flow (MGD)	Reported Monthly Average Quantity (kg/d)	Calculated Monthly Average Concentration (mg/L)
31-Jan-13	12.4	174	3.72
28-Feb-13	15.4	175	3.00
31-Mar-13	16.4	190	3.06
30-Apr-13	16.1	186	3.05
31-May-13	15.2	175	3.04
30-Jun-13	14.7	250	4.49[a]
31-Jul-13	14.5	244	4.46[a]
31-Aug-13	17.1	198	3.06
30-Sep-13	16.9	175	2.74
31-Oct-13	19.2	161	2.22
30-Nov-13	18.0	220	3.24
31-Dec-13	17.9	147	2.17

Source: *DMRLTOutput2013_v1.*
[a] Fluoride concentration exceeds daily maximum permit limit.

Table 3-25. U.S. Steel Granite City Works' Fluoride Discharges for 2011 – 2014

Year	Pounds of Fluoride Discharged	Fluoride TWPE
2011	163,000	4,880
2012	158,000	4,750
2013	154,000	4,620
2014	141,000	4,240

Source: *DMRLTOutput2013_v1;* DMR Loading Tool.

ArcelorMittal Burns Harbor LLC

ArcelorMittal Burns Harbor LLC, in Burns Harbor, IN, discharges fluoride from outfall 002. EPA has not previously reviewed fluoride discharges from this facility. Table 3-26 presents the facility's fluoride discharge data for 2013. EPA calculated the fluoride concentrations using the quantity and average monthly flows. As shown, the fluoride concentrations range from 0.070 mg/L to 0.194 mg/L. EPA determined that fluoride concentrations for ArcelorMittal Burns Harbor are generally below those achievable by current technologies, described above. Additionally, Table 3-27 presents the facility's fluoride discharges for 2011 through 2014. As shown, discharges increased from 2011 to 2012, but by 2014 had fallen back to below 2011 levels.

Table 3-26. ArcelorMittal Burns Harbor 2013 DMR Fluoride Discharges for Outfall 002

Date	Reported Monthly Average Flow (MGD)	Reported Monthly Average Quantity (kg/d)	Calculated Monthly Average Concentration (mg/L)
31-Jan-13	255	141	0.146
28-Feb-13	257	164	0.169
31-Mar-13	255	166	0.172
30-Apr-13	233	165	0.187
31-May-13	194	51.7	0.070
30-Jun-13	209	137	0.173
31-Jul-13	241	122	0.134
31-Aug-13	251	134	0.141
30-Sep-13	260	148	0.150
31-Oct-13	268	197	0.194
30-Nov-13	225	155	0.182
31-Dec-13	197	119	0.160

Source: *DMRLTOutput2013_v1*

Table 3-27. ArcelorMittal Burns Harbor Fluoride Discharges for 2011 – 2014

Year	Pounds of Fluoride Discharged	Fluoride TWPE
2011	84,700	2,540
2012	124,000	3,710
2013	114,000	3,410
2014	81,700	2,450

Source: *DMRLTOutput2013_v1;* DMR Loading Tool.

3.4.6 Iron and Steel Manufacturing Lead and Lead Compound Discharges in DMR and TRI

EPA has not previously reviewed lead discharges from Iron and Steel Manufacturing facilities. Lead is a regulated pollutant in the Iron and Steel Manufacturing ELG, with limitations for seven of the thirteen subcategories.[19]

EPA's review of the lead DMR data revealed that 33 facilities account for 8,760 TWPE, with no facility contributing more than 2,300 TWPE. EPA's investigation of TRI-reported lead and lead compound data revealed that 133 facilities account for 22,700 TWPE. EPA identified one facility, Charter Steel Cleveland, in Cuyahoga Heights, OH, that accounts for 4,360 TWPE (19 percent of the 2013 TRI lead and lead compound releases) (shown in Table 3-28). EPA further reviewed lead discharges for Charter Steel, as discussed below. EPA did not conduct facility-specific investigations of the 33 facilities with DMR lead discharges or the remaining 132 facilities reporting TRI releases of lead and lead compounds as part of the 2015 Annual Review because no facility contributes more than 2,300 TWPE.

Table 3-28. Top Facilities Reporting 2013 TRI Lead and Lead Compound Releases

Facility Name	Facility Location	Pounds of Pollutant Released	Pollutant TWPE	Percent of Category TWPE
Charter Steel Cleveland	Cuyahoga Heights, OH	1,950	4,360	19.2%
All other lead and lead compound releases in the Iron and Steel Manufacturing Category[a]		8,170	18,300	80.8%
Total		**10,100**	**22,700**	**100%**

Source: *TRILTOutput2013_v1.*
Note: Sums of individual values may not equal the total presented, due to rounding.
[a] 132 additional facilities reported lead and lead compound releases in the 2013 TRI.

Charter Steel Cleveland in Cuyahoga Heights, OH, reported both indirect and direct releases of lead and lead compounds to TRI. As part of the 2015 Annual Review, EPA contacted the facility to discuss their lead and lead compound TRI releases. A stormwater permit regulates the facility's stormwater releases to the Cuyahoga River. The facility does not have an individual NPDES permit. In addition to the direct stormwater release, the facility has two onsite pretreatment plants that discharge to the Northeast Ohio Regional Sewer District. The facility estimates indirect lead and lead compound releases by sampling at each pretreatment plant (Lawniczak, 2015).

The facility contact also explained that while calculating the amount of lead and lead compound releases transferred, they incorrectly converted from milligrams of lead to pounds of lead, resulting in an overestimate of the pounds reported to TRI for 2013. Correcting for this error decreases the facility's lead and lead compounds TRI TWPE from 4,360 to 1,090.

[19] Subpart B, Sintering Subcategory, Subpart C, Ironmaking Subcategory, Subpart D, Steelmaking Subcategory, Subpart E, Vacuum Degassing Subcategory, Subpart F, Continuous Casting Subcategory, Subpart I, Acid Pickling Subcategory, and Subpart J, Cold Forming Subcategory include limitations for lead.

The individual facility TWPE associated with lead discharges across the Iron and Steel Manufacturing Category appears to be relatively low (less than 2,300); however, a large number of facilities reported lead discharges on DMRs and lead and lead compound releases to TRI in 2013.

3.4.7 Iron and Steel Manufacturing Nitrate Compound Releases in TRI

EPA has not previously reviewed nitrate compound discharges from Iron and Steel Manufacturing facilities. Nitrate compounds are not regulated pollutants in the Iron and Steel Manufacturing Category ELG; however, three subparts have ammonia as N limitations.[20]

EPA's investigation of the nitrate compound data revealed that one facility, AK Steel Corporation, in Rockport, IN, accounts for 47 percent of the 2013 nitrate releases (shown in Table 3-29). EPA did not investigate the remaining 55 facilities reporting releases of nitrate as part of the 2015 Annual Review because no individual facility contributes more than 3,200 TWPE.

Table 3-29. Top Facilities Reporting 2013 TRI Nitrate Compound Releases

Facility Name	Facility Location	Pounds of Pollutant Released	Pollutant TWPE	Percent of Category TWPE
AK Steel Corporation, Rockport Works	Rockport, IN	15,900,000	11,900	46.6%
All other nitrate-releasing facilities in the Iron and Steel Manufacturing Category[a]		18,200,000	13,600	53.4%
Total		**34,100,000**	**25,400**	**100%**

Source: *TRILTOutput2013_v1*.
Note: Sums of individual values may not equal the total presented, due to rounding.
[a] 55 additional facilities reported nitrate compound releases in the 2013 TRI.

AK Steel Corporation Rockport Works, in Rockport, IN, is an integrated steel mill, manufacturing iron and steel products and coke and cokemaking byproducts. The facility releases directly to the Grand Calumet River and Lake Michigan. The facility has report-only requirements for ammonia as N in their NPDES permit, but does not have nitrate compound reporting requirements (IDEM, 2011). As part of the 2015 Annual Review, EPA contacted AK Steel to discuss the Rockport facility nitrate compound releases reported to TRI.

The AK Steel contact stated that nitrate compound releases are calculated the same at each AK Steel facility. Each facility obtains a weekly composite outfall sample and analyzes it for nitrate as nitrogen. The facility averages the weekly concentrations for each month, multiplies by the average daily flow and the number of days in the month, and converts to pounds. This determines the pounds per month of nitrate as nitrogen released at the outfall. To calculate the amount of nitrate compounds as required for TRI reporting, the facility then converts the pounds per month of nitrate as nitrogen to pounds of nitrate as nitrate compounds,

[20] Subpart A, Cokemaking Subcategory, Subpart B, Sintering Subcategory, and Subpart C, Ironmaking Subcategory, include limitations for Ammonia as N.

by multiplying by the molecular weight ratio of nitrate to nitrogen.[21] This step determines the pounds of nitrate compounds released per month. The facility totals each month to obtain the annual total nitrate compounds released (Miracle, 2015). Table 3-30 presents the nitrate compound releases for 2008 through 2013 for AK Steel Rockport Works. As shown, releases decreased from 2010 to 2012, then increased again in 2013. The facility's nitrate compound releases are the same order of magnitude as the other 55 facilities with nitrate compound releases combined, as shown in Table 3-29.

Table 3-30. AK Steel Rockport Works' TRI-Reported Nitrate Compound Releases for 2008 – 2013

Year	Pounds of Nitrate Released	Nitrate TWPE
2008	17,300,000	12,900
2009	12,100,000	9,050
2010	23,500,000	17,600
2011	18,400,000	13,700
2012	14,400,000	10,800
2013	15,900,000	11,900

Source: *TRILTOutput2013_v1;* DMR Loading Tool.

In general, the individual facility TWPE associated with nitrate discharges across the Iron and Steel Manufacturing Category appears to be relatively low (less than 3,200); however, a large number of facilities reported nitrate compound releases to TRI in 2013.

3.4.8 Iron and Steel Manufacturing Category Findings

The estimated toxicity of the Iron and Steel Manufacturing Category discharges resulted primarily from PCBs, cyanide, fluoride, and lead discharges reported on DMRs, and nitrate compound, lead and lead compound, manganese and manganese compound, and copper and copper compound releases reported to TRI. From the 2015 Annual Review, EPA found:

- ***PCBs.*** One facility, U.S. Steel Fairless Hills Works, in Fairless Hills, PA, accounts for 100 percent of the DMR PCB discharges. The facility is working with the Delaware River Basin Commission (DRBC) to determine the source of the PCB discharges, but believes the discharges are from historical production activities on the site. The facility's PCB discharges have also decreased from 2013 to 2014. For these reasons, EPA does not consider the facility's PCB discharges to be representative of discharges across the category.
- ***Cyanide.*** Two facilities, Mountain State Carbon, in Follansbee, WV, and U.S. Steel Clairton Plant, in Clairton, PA, account for 76 percent of the DMR cyanide discharges. EPA reviewed the cyanide discharges and found:
  - EPA identified an error in Mountain State Carbon's cyanide discharges. Correcting this error decreases the facility's cyanide TWPE from 12,100 to 5,570. However, two months of cyanide discharges from one outfall at Mountain State Carbon exceed the facility's permit limits.

[21] Molecular weight ratio is 4.43: the molecular weight of nitrate is 62; the molecular weight of nitrogen is 14.

  - U.S. Steel Clairton Plant's cyanide discharges are below permit limits and the LTA for cyanide calculated for the 2002 rulemaking. The facility's high cyanide TWPE is likely the result of the large amount of industrial activity at the facility, as it has historically been the top coke producer in the U.S.
  - Because the majority of cyanide discharges from the Iron and Steel Manufacturing Category are attributed to two facilities, EPA does not consider them to be representative of the Iron and Steel Category.
- ***Fluoride.*** Four facilities account for 94 percent of DMR fluoride discharges. EPA determined that current wastewater technologies (not specific to iron and steel) are achieving effluent concentrations between 2 mg/L and 15 mg/L. For two of the top fluoride discharging facilities, EPA concluded that the fluoride concentrations are generally below those achievable by current technologies. One facility, ArcelorMittal Weirton LLC in Weirton, WV, received a revised permit in 2014 that includes fluoride limits for outfalls 003 and 004. Therefore, EPA expects that fluoride discharges will decrease on future DMRs for this facility. The remaining facility, U.S. Steel Granite City Works, has discharges above permit limits.
- ***Lead.*** One facility, Charter Steel Cleveland, in Cuyahoga Heights, OH, accounts for 19 percent of the TRI lead and lead compound releases. The facility identified a data error in the indirect releases reported to TRI. Correcting this error, decreases the facility's lead and lead compound TWPE from 4,360 to 1,100. After the correction for Charter Steel Cleveland, EPA determined that all facilities with lead discharges in the 2013 DMR and TRI databases contributed less than 2,300 TWPE each. However, EPA notes that a large number of facilities reported lead and lead compounds to TRI and lead discharges on DMRs in 2013 (133 and 33 facilities, respectively).
- ***Nitrate.*** One facility, AK Steel Corporation Rockport Works, in Rockport, IN, accounts for 47 percent of the TRI nitrate compound releases and bases its load reported to TRI on sampling data. The individual facility TWPE associated with nitrate discharges across the remainder of the Iron and Steel Manufacturing Category appears to be relatively low (less than 3,200); however, EPA notes that a large number of facilities (56 facilities) reported nitrate releases to TRI in 2013.
- ***Manganese and Copper.*** EPA did not further investigate manganese and manganese compounds and copper and copper compounds as part of the 2015 Annual Review because they contribute a small amount of TWPE relative to the other top pollutants (less than 6,000 TWPE each). However, EPA notes that a large number of facilities reported manganese and manganese compound and copper and copper compound releases to TRI in 2013 (114 and 79 facilities, respectively) and these pollutants are not regulated by the Iron and Steel Manufacturing ELGs.

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3.5 Landfills (40 CFR Part 445)

EPA identified the Landfills Category for preliminary review because it ranks high again, in terms of toxic-weighted pound equivalents (TWPE), in the final 2015 combined point source category rankings. Previously, EPA reviewed discharges from this category as part of the 2010 and 2011 Annual Reviews in which it also ranked high (U.S. EPA, 2011, 2012). This section summarizes the results of the 2015 Annual Review. EPA focused its 2015 review on discharges of cadmium, selenium, and iron because of their high TWPE relative to the other pollutants discharged by facilities in the Landfills Category. Of these three pollutants, only iron was reviewed in the 2010 and 2011 Annual Reviews. For the 2015 Annual Review, available discharge data also showed significant contributions of cadmium and selenium.

3.5.1 Landfills Category 2015 Toxicity Rankings Analysis

Table 3-31 compares the toxicity ranking analyses (TRA) data for the Landfills Category from the 2011, 2013, and 2015 Annual Reviews. EPA did not conduct the TRA in 2012 or 2014, but instead reviewed additional data sources as part of the even-year annual review, as described in Section 2.2.1 of EPA's Preliminary 2016 Plan (U.S. EPA, 2016). As discussed in this section, during the 2015 Annual Review, EPA identified data corrections that affected the 2013 Discharge Monitoring Report (DMR) data and TWPE. The bottom row of Table 3-31 shows the corrected data resulting from this review.

Table 3-31. Landfills Category TRI and DMR Facility Counts and Discharges Reported in 2009, 2011, and 2013

<table>
<tr><th rowspan="2">Year of Discharge</th><th rowspan="2">Year of Review</th><th colspan="3">Landfills Category Facility Counts[a]</th><th colspan="3">Landfills Category TWPE</th></tr>
<tr><th>Total TRI Facilities</th><th>Total DMR Major Facilities</th><th>Total DMR Minor Facilities</th><th>TRI TWPE[b]</th><th>DMR TWPE[c]</th><th>Total TWPE</th></tr>
<tr><td>2009</td><td>2011</td><td>19</td><td>7</td><td>194</td><td>2,750</td><td>29,700[d]</td><td>32,400[d]</td></tr>
<tr><td>2011</td><td>2013</td><td>1</td><td>5</td><td>190</td><td>42,900[e]</td><td>19,300</td><td>62,100</td></tr>
<tr><td rowspan="2">2013</td><td rowspan="2">2015</td><td rowspan="2">4</td><td rowspan="2">4</td><td rowspan="2">175</td><td rowspan="2">235</td><td>166,000[f]</td><td>166,000[f]</td></tr>
<tr><td>116,000[g]</td><td>116,000[g]</td></tr>
</table>

Sources: *TRIReleases2009_v2*, *DMRLoads2009_v2*, and 2011 Annual Review Report (for 2009 DMR data) (U.S. EPA, 2012); *DMRLTOutput2011_v1* (for 2011 DMR); *TRILTOutput2011_v1* (for 2011 TRI); *DMRLTOutput2013_v1* (for 2013 DMR); *TRILTOutput2013_v1* (for 2013 TRI)
Note: EPA did not evaluate 2010 or 2012 DMR and TRI data
Note: TWPE values are rounded to three significant figures. Sums of individual values may not equal the total presented, due to rounding.

a Number of facilities with TWPE greater than zero.
b Releases include direct discharges to surface waters and transfers to POTWs. Transfers to POTWs account for POTW removals.
c Includes DMR data from both major and minor dischargers.
d 2009 data after corrections were made during the 2011 Annual Review.
e The majority of the 2011 TRI TWPE was attributed to one facility, Clean Harbors Deer Park LLC in La Porte, TX. This facility was reassigned to the Unassigned Waste Facility Category.
f 2013 data prior to corrections made during the 2015 Annual Review.
g 2013 data after corrections were made during the 2015 Annual Review.

As shown in Table 3-31, the total TWPE increased from 2009 to 2013, while the number of Toxic Release Inventory (TRI) facilities and DMR facilities decreased from 2009 to 2013.

3.5.2 Landfills Category Pollutants of Concern

EPA's 2015 review of the Landfills Category focused on the 2013 DMR discharges because the DMR data dominate the category's combined TWPE. Table 3-32 shows the five pollutants with the highest contribution to the 2013 DMR TWPE. Table 3-32 also presents the 2013 DMR TWPE after EPA corrected two errors identified in this preliminary category review (discussed in the sections below). As a point of comparison, Table 3-32 shows the 2011 DMR facility count and TWPE for these top pollutants, based on the 2013 Annual Review (U.S. EPA, 2014).

Cadmium, selenium, and iron contribute more than 88 percent of the original 2013 DMR TWPE for the Landfills Category (prior to corrections discussed below). Cadmium, selenium, and iron are not regulated in the Landfills Category effluent limitations guidelines and standards (ELGs) (40 CFR Part 445). EPA's investigations of reported discharges of the top three pollutants are presented in Sections 3.5.3, 3.5.4, and 3.5.5. EPA did not investigate the other pollutants, including arsenic and silver, as part of the 2015 Annual Review, because they represent a small percentage (6 percent) of the 2013 DMR TWPE for the Landfills Category.

Table 3-32. Landfills Category Top DMR Pollutants

	2013 DMR Data[a]			2011 DMR Data[a]	
Pollutant[b]	Number of Facilities Reporting Pollutant[c]	Original TWPE	Corrected TWPE	Number of Facilities Reporting Pollutant[c]	TWPE
Cadmium	25	91,700	91,700	28	1,370
Selenium	23	40,800	195	23	249
Iron	138	14,500	4,910	136	5,050
Arsenic	37	8,010	8,010	32	1,370
Silver	9	2,270	2,270	8	1,590
Top Pollutant Total	**NA**	**157,000**	**107,000**	**NA**	**9,630**
Landfills Category Total	**179**	**166,000**	**116,000**	**195**	**19,300**

Sources: *DMRLTOutput2013_v1* (for 2013 TWPE); *DMRLTOutput2011_v1* (for 2011 TWPE)
Note: Sums of individual values may not equal the total presented, due to rounding.
NA: Not applicable.
a Includes DMR data from both major and minor dischargers.
b Arsenic and silver discharges combined contribute 6 percent of the original 2013 category DMR TWPE. Therefore, EPA did not review arsenic or silver discharges as part of the 2015 Annual Review.
c Number of facilities with TWPE greater than zero.

3.5.3 Landfills Category Cadmium Discharges in DMR

EPA's investigation of the cadmium discharges revealed that one facility, Henderson City Landfill in Henderson, KY, accounts for over 99 percent of the 2013 DMR cadmium discharges (shown in Table 3-33). EPA did not investigate the remaining facilities discharging cadmium as part of the 2015 Annual Review.

Table 3-33. Top 2013 DMR Cadmium Discharging Facilities

Facility Name	Facility Location	Pounds of Pollutant Discharged	Pollutant TWPE	Percent of Category TWPE
Henderson City Landfill	Henderson, KY	3,940	91,100	99.3
All other cadmium dischargers in the Landfills Category[a]		26.4	610	0.7
Total		**3,970**	**91,700**	**100%**

Source: *DMRLTOutput2013_v1*.
Note: Sums of individual values may not equal the total presented, due to rounding.
[a] 24 additional facilities submitted cadmium discharges in the 2013 DMR data.

Henderson City Landfill in Henderson, KY, discharges cadmium through two outfalls and reports quarterly cadmium concentrations, shown in Table 3-34. As shown in Table 3-34, March 2013 discharges from outfall 001 are significantly greater than other discharges. As part of the 2015 Annual Review, EPA contacted the facility about their cadmium discharges. The facility contact confirmed the 2013 cadmium discharges and explained that the March 2013 concentration is an outlier. The facility experienced a large rainstorm event during this month, which caused a leachate tank flood on the same day sampling was conducted at the outfall. The March 2013 sample was not representative of typical operation conditions at the facility (Williams, 2015). EPA reviewed 2014 cadmium discharges and confirmed the total cadmium TWPE to be 0.8.

Table 3-34. Henderson City Landfill's 2013 DMR Quarterly Cadmium Discharges

Outfall	Date	Monthly Average Flow (MGD)	Monthly Average Cadmium Concentration (mg/L)
001	31-Mar-13	0.100	52.50
001	30-Jun-13	0.014	0.001
001	30-Sep-13	No Discharge	
001	31-Dec-13	0.006	0.00005
002	31-Mar-13	0.036	0.001
002	30-Jun-13	0.021	0.001
002	30-Sep-13	0.001	0.001
002	31-Dec-13	0.005	0.001

Source: *DMRLTOutput2013_v1*.

3.5.4 Landfills Category Selenium Discharges in DMR

EPA's investigation of the selenium discharges revealed that one facility, South Carolina Generating Company (SCGENCO)/Williams Ash Disposal Facility in Moncks Corner, SC, accounts for over 99 percent of the 2013 DMR selenium discharges (shown in Table 3-35). EPA did not investigate the remaining facilities discharging selenium as part of the 2015 Annual Review.

Table 3-35. Top 2013 DMR Selenium Discharging Facilities

Facility Name	Facility Location	Pounds of Pollutant Discharged	Pollutant TWPE	Percent of Category TWPE
SCGENCO/Williams Ash Disposal Facility	Moncks Corner, SC	36,300	40,600	99.5
All other selenium dischargers in the Landfills Category[a]		175	195	0.5
Total		**36,500**	**40,800**	**100%**

Source: *DMRLTOutput2013_v1.*
Note: Sums of individual values may not equal the total presented, due to rounding.
[a] 22 additional facilities submitted selenium discharges in the 2013 DMR data.

SCGENCO/Williams Ash Disposal Facility is a landfill for the disposal of coal ash and gypsum from SCGENCO/Williams Station in Goose Creek, SC (SH DHEC, 2013a). SCGENCO discharges selenium from one outfall, which contains ash landfill runoff, ash landfill leachate, and truck wash water (SC DHEC, 2013b). As part of the 2015 Annual Review, EPA contacted the South Carolina Department of Health and Environmental Control (SC DHEC) to confirm the facility's selenium discharges. SC DHEC indicated that the facility's 2013 selenium concentrations were reported in units of micrograms per liter (µg/L) instead of milligrams per liter (mg/L) (Rippy, 2015). Table 3-36 presents the original and corrected concentrations, and average flow rates from the facility. After correcting the concentrations, the facility's selenium TWPE decreases from 40,600 to 40.4.

Table 3-36. SCGENCO/Williams Ash Disposal Facility's 2013 DMR Original and Corrected Selenium Discharges from Outfall 001

Date	Monthly Average Flow (MGD)	Original Monthly Average Selenium Concentration (mg/L)	Corrected Monthly Average Selenium Concentration (mg/L)
31-Jan-13	0.27	6.1	0.0061
29-Feb-13	1.21	15.8	0.0158
31-Mar-13	0.33	16.4	0.0164
30-Apr-13	0.16	21.1	0.0211
31-May-13	0.45	22.9	0.0229
30-Jun-13	No Discharge		
31-Jul-13	1.17	25.6	0.0256
31-Aug-13	1.29	28.4	0.0284
30-Sep-13	No Discharge		

Source: *DMRLTOutput2013_v1.*

SC DHEC also provided the facility's NPDES permit and permit rationale. SCGENCO/Williams Ash Disposal Facility's NPDES permit (SC0046175), effective March 4, 2009 to September 30, 2013, required monthly monitoring and reporting for selenium (SC DHEC, 2009a, 2009b). When the permit was reissued in 2013 (effective October 1, 2013), neither monitoring requirements nor permit limits were placed on selenium because SC DHEC determined that the selenium discharges showed no reasonable potential to cause or contribute to a water quality violation (SC DHEC, 2013a, 2013b). For this reason, selenium discharges were only reported through September 2013, as shown in Table 3-36.

Additionally, after reviewing SCGENCO/Williams Ash Disposal Facility's NPDES permit, EPA determined that the landfill operates and receives waste directly from the SCGENCO Williams Station coal-fired power plant. The Landfills ELGs do not apply to discharges of landfill wastewater from landfills operated in conjunction with other industrial or commercial operations when the landfill only receives wastes generated by the industrial or commercial operation directly associated with the landfill (40 CFR Part 445). For this reason, EPA determined that SCGENCO should instead be classified under the Steam Electric Power Generating Category (40 CFR Part 423).

3.5.5 Landfills Category Iron Discharges in DMR

EPA's investigation of iron discharges revealed that two facilities, Bluegrass Containment LLC, in Hartford, KY, and Bavarian Trucking, in Walton, KY, account for over 85 percent of the 2013 DMR iron discharges (shown in Table 3-37). EPA did not investigate the remaining facilities discharging iron as part of the 2015 Annual Review.

Table 3-37. Top 2013 DMR Iron Discharging Facilities

Facility Name	Facility Location	Pounds of Pollutant Discharged	Pollutant TWPE	Percent of Category TWPE
Bluegrass Containment LLC	Hartford, KY	1,720,000	9,620	66.2
Bavarian Trucking	Walton, KY	501,000	2,810	19.3
All other iron dischargers in the Landfills Category[a]		375,000	2,100	14.5
Total		**2,590,000**	**14,500**	**100%**

Source: *DMRLTOutput2013_v1*.
Note: Sums of individual values may not equal the total presented, due to rounding.
[a] 136 additional facilities submitted iron discharges in the 2013 DMR data.

Bluegrass Containment LLC

Bluegrass Containment LLC discharges iron from one outfall and reports monthly iron concentrations, shown in Table 3-38 for 2013. As shown in Table 3-38, the February 2013 iron concentration reported from outfall 001 was far greater than other months' concentrations. As part of the 2015 Annual Review, EPA contacted the Kentucky Department for Environmental Protection, which confirmed the February 2013 iron concentration (Milburn, 2015). EPA also contacted the laboratory that submitted the DMR on behalf of Bluegrass Containment LLC. The laboratory contact indicated that the February 2013 iron concentration was measured in µg/L and incorrectly converted to mg/L on the DMR by multiplying by 1,000 instead of dividing by 1,000. The correct iron concentration is 0.525 mg/L (Gish, 2015). Table 3-38 presents the original and corrected concentrations, and average flow rates from the facility. Correcting the concentrations, decreases the facility's iron TWPE from 9,620 to 0.015, reducing the Landfills Category iron TWPE from 14,500 to 4,910, as shown in Table 3-32.

Table 3-38. Bluegrass Containment LLC's 2013 DMR Original and Corrected Iron Discharges from Outfall 001

Date	Monthly Average Flow (MGD)	Original Monthly Average Iron Concentration (mg/L)	Corrected Monthly Average Iron Concentration (mg/L)
31-Jan-13	0.36	1.07	1.07
29-Feb-13	0.014	525,000	0.525
31-Mar-13	0.108	0.66	0.66
30-Apr-13	0.004	0.14	0.14
31-May-13	0.072	0.27	0.27
30-Jun-13	0.57	0.24	0.24
31-Jul-13	0.014	0.101	0.101
31-Aug-13	0.001	0.15	0.15
30-Sep-13	0.005	0.15	0.15
31-Oct-13	0.00001	0.36	0.36
30-Nov-13	0.001	0.36	0.36
31-Dec-13	0.004	0.15	0.15

Source: *DMRLTOutput2013_v1.*

Bavarian Trucking

Bavarian Trucking discharges iron from one outfall and reports daily maximum and monthly average iron concentrations, shown in Table 3-39. The facility has a daily maximum iron limit of 4 mg/L. As shown in Table 3-39, the iron concentrations exceed the permit limit during several months in 2013. The facility's Clean Water Act compliance status was classified as Category I[22] during 2013 due to several effluent violations of permit limits for iron and other pollutants.

[22] Severity of violations is calculated according to the Clean Water Act regulations, which have specific criteria specifying the duration, severity, and type of violations that rise to the level of Significant Noncompliance (SNC). SNC can occur at major facilities. The calculation of "Category I" violations is equivalent to the SNC calculations, but because the violations occur at smaller dischargers (non-major), EPA does not classify the violations as SNC.

Table 3-39. Bavarian Trucking's 2013 DMR Iron Discharges from Outfall 001

Date	Monthly Average Flow (MGD)	Daily Maximum/Monthly Average Iron Concentration (mg/L)[a]
31-Jan-13	0.160	13.4
29-Feb-13	0.209	87.2
31-Mar-13	No Discharge	
30-Apr-13	0.170	9.11
31-May-13	0.084	35.7
30-Jun-13	467	3.61
31-Jul-13	No Discharge	
31-Aug-13	0.320	852
30-Sep-13	No Discharge	
31-Oct-13	0.039	3.12
30-Nov-13	0.029	0.326
31-Dec-13	0.380	17.7

Source: *DMRLTOutput2013_v1; US EPA, 2015.*

[a] The facility reported the same concentration values for daily maximum and monthly average for each monitoring period in 2013.

3.5.6 Landfills Category Findings

The estimated toxicity of the Landfills Category discharges resulted primarily from cadmium, selenium, and iron discharges reported on DMRs. From the 2015 Annual Review, EPA found:

- ***Cadmium.*** One facility, Henderson City Landfill in Henderson, KY, accounts for more than 99 percent of the 2013 DMR cadmium discharges. The large discharge can be attributed to a single sampling event that was performed after a leachate tank flood and was not representative of typical operating conditions at the facility. For this reason, EPA does not consider these discharges to be representative of the Landfills Category.
- ***Selenium.*** One facility, SCGENCO/Williams Ash Disposal Facility, in Moncks Corner, SC, accounts for more than 99 percent of the 2013 DMR selenium discharges. SC DHEC confirmed that the selenium concentrations were reported in units of µg/L instead of mg/L. Incorporating this correction decreases the facility's selenium TWPE from 40,600 to 40.4.
- ***Iron.*** Two facilities, Bluegrass Containment in Hartford, KY, and Bavarian Trucking in Walton, KY, account for over 85 percent of the iron discharges in the 2013 DMR data. EPA identified an error in the concentration data for iron for Bluegrass Containment. With this error corrected, the facility's iron TWPE decreases from 9,620 to 0.015, reducing the Landfills Category iron TWPE from 14,500 to 4,910. Bavarian Trucking exceeded its permit limit for iron during 2013.

3.5.7 Landfills Category References

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10. U.S. EPA. 2012. *The 2011 Annual Effluent Guidelines Review Report.* Washington, D.C. (December). EPA 821-R-12-001. EPA-HQ-OW-2010-0824-0195.

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3.6 Meat and Poultry Products (40 CFR Part 432)

EPA identified the Meat and Poultry Products (Meat and Poultry) Category for preliminary review because it ranks high again, in terms of toxic-weighted pound equivalents (TWPE), in the final 2015 combined point source category rankings. Previously, EPA reviewed discharges from this category as part of the 2011 to 2013 Annual Reviews in which it also ranked high (U.S. EPA, 2012, 2014a, 2014b). This section summarizes the results of the 2015 Annual Review. EPA focused its 2015 review on discharges of nitrate compounds and hydrogen sulfide because of their high TWPE relative to other pollutants discharged by facilities in the Meat and Poultry Category. Nitrate, reviewed as part of the 2011 and 2012 Annual Reviews, continues to be a top pollutant of concern. Hydrogen sulfide was added as a Toxic Release Inventory (TRI) reporting requirement in 2012. As a result, in 2013, hydrogen sulfide contributed a substantial amount of TWPE for the category. Therefore, for the 2015 Annual Review, available discharge data also showed significant contributions of hydrogen sulfide to the Meat and Poultry Category TWPE.

3.6.1 Meat and Poultry Category 2015 Toxicity Rankings Analysis

Table 3-40 compares the toxicity rankings analyses (TRA) data for the Meat and Poultry Category from the 2011, 2013, and 2015 Annual Reviews. EPA did not conduct the TRA in 2012 or 2014, but instead reviewed additional data sources as part of the even-year annual review, as described in Section 2.2.1 of EPA's Preliminary 2016 Plan (U.S. EPA, 2016). During the 2015 Annual Review, EPA did not identify any data corrections to the 2013 discharge monitoring report (DMR) or TRI data for the Meat and Poultry Category.

Table 3-40. Meat and Poultry Category TRI and DMR Facility Counts and Discharges Reported in 2009, 2011, and 2013

		Meat and Poultry Category Facility Counts[a]			Meat and Poultry Category TWPE		
Year of Discharge	Year of Review	Total TRI Facilities	Total DMR Major Facilities	Total DMR Minor Facilities	TRI TWPE[b]	DMR TWPE[c]	Total TWPE
2009	2011	173	38	88	53,800	17,200	71,000
2011	2013	156	32	99	39,100	13,700[d]	52,800[d]
2013	2015	179	29	46	81,500	8,220	89,700

Sources: *TRIReleases2009_v2*, *DMRLoads2009_v2*, and 2011 Annual Review Report (for 2009 DMR and TRI data) (U.S. EPA, 2012); *DMRLTOutput2011_v1* (for 2011 DMR); *TRILTOutput2011_v1* (for 2011 TRI); *DMRLTOutput2013_v1* (for 2013 DMR); *TRILTOutput2013_v1* (for 2013 TRI).
Note: EPA did not evaluate 2010 or 2012 DMR and TRI data.
Note: TWPE values are rounded to three significant figures. Sums of individual values may not equal the total presented, due to rounding.

a Number of facilities with TWPE greater than zero.
b Releases include direct discharges to surface waters and transfers to POTWs. Transfers to POTWs account for POTW removals. The 2013 TRI TWPE also includes TWPE associated with reported releases of hydrogen sulfide. Facilities began reporting releases of hydrogen sulfide to TRI in 2012.
c Includes DMR data from both major and minor dischargers.
d 2011 data after corrections were made during the 2013 Annual Review.

As shown in Table 3-40, the total number of facilities reporting releases to TRI, and their respective TWPE, decreased from 2009 to 2011, but increased in 2013. During that same time period, the total number of facilities reporting discharges on DMRs and their respective TWPE decreased. The increase in TRI TWPE in 2013 is primarily due to releases from the facilities described in the sections below.

3.6.2 Meat and Poultry Category Pollutants of Concern

EPA's 2015 review of the Meat and Poultry Category focused on the 2013 TRI releases because the TRI data dominate the category's combined TWPE. Table 3-41 shows the five pollutants with the highest contribution to the 2013 TRI TWPE. As a point of comparison, Table 3-41 also shows the 2011 TRI facility count and TWPE for these top five pollutants, based on the 2013 Annual Review (U.S. EPA, 2014b). Nitrate compounds and hydrogen sulfide contribute more than 98 percent of the total 2013 TRI TWPE. Because hydrogen sulfide was added as a TRI reporting requirement in 2012, no hydrogen sulfide releases were reported in 2011. EPA's investigations of reported releases of the top two pollutants are presented in Sections 3.6.3 and 3.6.4. EPA did not investigate the other pollutants, including ammonia, sodium nitrite, and mercury and mercury compounds, as part of the 2015 Annual Review, because they represent a small percentage (less than 2 percent) of the 2013 TRI TWPE for the Meat and Poultry Category.

Table 3-41. Meat and Poultry Category Top TRI Pollutants

Pollutant[a]	2013 TRI Data		2011 TRI Data	
	Number of Facilities Reporting Pollutant[b]	TWPE	Number of Facilities Reporting Pollutant[b]	TWPE
Nitrate Compounds	117	42,300	105	38,000
Hydrogen Sulfide	11	37,700	NA[c]	NA[c]
Ammonia	118	797	114	876
Sodium Nitrite	11	455	5	16.8
Mercury and Mercury Compounds	1	155	1	170
Top Pollutant Total	**NA**	**81,500**	**NA**	**39,100**
Meat and Poultry Category Total	**179**	**81,500**	**156**	**39,100**

Sources: *TRILTOutput2013_v1* (for 2013 TWPE); *TRILTOutput2011_v1* (for 2011 TWPE).
Note: Sums of individual values may not equal the total presented, due to rounding.
NA: Not applicable.
a Ammonia, sodium nitrite, and mercury and mercury compounds releases combined contribute less than 2 percent of the 2013 category TRI TWPE. Therefore, EPA did not review any of these releases as part of the 2015 Annual Review.
b Number of facilities with TWPE greater than zero.
c Hydrogen sulfide was added as a TRI reporting requirement in 2012; it was not a TRI-listed chemical in 2011.

3.6.3 Meat and Poultry Category Nitrate Compound Releases in TRI

EPA's investigation of the nitrate compound releases revealed that 15 facilities account for approximately 59 percent of the 2013 TRI nitrate compound releases (as shown in Table 3-42). EPA did not investigate the remaining facilities discharging nitrate compounds as part of the

2015 Annual Review. EPA reviewed nitrate compound releases from the Meat and Poultry Category in detail as part of the 2011 and 2012 Annual Reviews.[23] Therefore, Table 3-42 also presents the 2009 TRI nitrate compound TWPE for comparison purposes.

[23] EPA reviewed 2009 DMR and TRI data as part of the 2011 and 2012 Annual Reviews.

Table 3-42. Top Facilities Reporting 2013 TRI Nitrate Compound Releases

Facility Name	2013 TRI Data					2009 TRI Data[a]
	Location	Subcategory	Nitrate Compound Pounds Released	Nitrate Compound TWPE	Percent of Nitrate Compound Category TWPE	Nitrate Compound TWPE
Cargill Meat Solutions Corp.	Schuyler, NE	B	4,770,000	3,560	8.42%	2,870
Cargill Meat Solutions Corp.	Ottumwa, IA	Undetermined	3,090,000	2,310	5.45%	686[b]
John Morrell & Co.	Sioux Falls, SD	Undetermined	2,870,000	2,150	5.07%	17.2[b]
Pilgrim's Pride Corp Mt. Pleasant Complex	Mount Pleasant, TX	K	2,590,000	1,930	4.56%	1,040
Cargill Meat Solutions Corp.	Beardstown, IL	B	2,540,000	1,900	4.49%	2,730
Tyson Fresh Meats Inc. – Joslin, IL	Hillsdale, IL	B	2,530,000	1,890	4.46%	3,320
Lewiston Processing Plant	Lewiston Woodville, NC	L	2,050,000	1,530	3.61%	2,440
Tyson Fresh Meats Inc.	Lexington, NE	B	1,890,000	1,410	3.34%	3,730
Tyson Fresh Meats Inc.	Columbus Junction, IA	B	1,880,000	1,400	3.32%	1,210
Smithfield Packing Co., Inc., Tar Heel Div.	Tar Heel, NC	B	1,840,000	1,370	3.24%	2,800
Tyson Farms Inc. – Carthage, MS Processing Plant	Carthage, MS	K	1,720,000	1,280	3.03%	251[b]
Accomac Processing Plant	Accomac, VA	K	1,520,000	1,130	2.68%	1,550
JBS Plainwell	Plainwell, MI	B	1,330,000	997	2.35%	1,300
Cargill Meat Solutions Corp.	Fort Morgan, CO	Undetermined	1,290,000	966	2.28%	761[b]
Tyson Farms Inc. - Blountsville Processing Plant	Blountsville, AL	L	1,290,000	964	2.28%	1,110
Remaining Facilities Reporting Nitrate Compounds Releases [c]			23,500,000	17,500	41.4 %	23,500
Total			**56,700,000**	**42,300**	**100%**	**46,900**

Source: *TRIReleases2009_v2* (for 2009 TRI), *TRILTOutput2013_v1* (for 2013 TRI); 2011 Annual Review Report (for 2009 TRI data and Subcategories) (U.S. EPA, 2012); and 2012 Annual Review Report (for Subcategories) (U.S. EPA, 2014a).

Note: EPA determined subcategories by reviewing available permits.

a EPA reviewed 2009 nitrate compound releases as part of the 2011 and 2012 Annual Reviews. Therefore, 2009 data is presented for comparison purposes.

b The facility was not reviewed as part of the 2011 or 2012 Annual Reviews.

c 102 additional facilities reported nitrate compound releases in the 2013 TRI database, which account for approximately 41 percent of the category's nitrate compounds 2013 TRI TWPE.

EPA has identified several forms of nitrogen as pollutants of concern in meat and poultry processing wastewaters: total Kjeldahl nitrogen (TKN), ammonia nitrogen, and nitrite plus nitrate-nitrogen. Because protein is a major component of both meat and blood, meat and poultry wastewaters can contain high concentrations of nitrogen. The biological removal of nitrogen from wastewaters is a two-step process beginning with nitrification followed by denitrification. Under anaerobic conditions, ammonia is oxidized to nitrite, which is oxidized to nitrate in the process of nitrification. Following the anaerobic conditions, nitrite and nitrate are reduced microbially by denitrification, producing nitrogen gas as the principal end product (U.S. EPA, 2002).

Nitrite and nitrate-nitrogen are rarely present before aerobic biological treatment due to the lack of oxygen necessary for microbially-mediated nitrification. Therefore, the principal source of nitrite and nitrate-nitrogen is nitrification. Biological treatment is often required, at least seasonally, to satisfy effluent limitations for the discharge of ammonia nitrogen to surface waters. Many NPDES permits are written with seasonal limits for ammonia because the lower pH and temperature of the receiving waters during winter reduce the toxicity of ammonia by converting it to ammonium (U.S. EPA, 2002).

40 CFR Part 432 regulates wastewater discharges from Meat and Poultry processing plants in 12 subcategories of products and product groups. EPA last updated effluent limitations guidelines and standards (ELGs) for the Meat and Poultry Category on September 8, 2004 (69 FR 54476). In addition to best practicable control technology (BPT) limitations, 40 CFR Part 432 includes limitations based on the best available technology economically achievable (BAT) and new source performance standards (NSPS). 40 CFR Part 432 regulates conventional pollutants (BOD, fecal coliform, oil and grease, and TSS) for all subparts. Excluding Subpart E (Small Processors), all subparts include ammonia as nitrogen (N) and total nitrogen limitations for BAT, at plants exceeding a threshold pounds of annual live weight kill (LWK) (40 CFR Part 432) (U.S. EPA, 2014a). BAT treatment varies based on subcategory. Table 3-43 lists the BAT options for the Meat and Poultry subcategories. The Meat and Poultry Category ELGs do not regulate nitrate.

Table 3-43. BAT Treatment for the Meat and Poultry Subcategories

Subcategory	Treatment Unit Processes
A–D	Dissolved air flotation, lagoon, nitrification, denitrification, and disinfection
E	NA (no BAT limits)
F–I	Dissolved air flotation, lagoon, nitrification, denitrification, and disinfection
K	Dissolved air flotation, nitrification, denitrification, and disinfection
L	Dissolved air flotation, lagoon, nitrification, denitrification, and disinfection
J	Dissolved air flotation, nitrification, denitrification, and disinfection

Source: U.S. EPA, 2002.

Thirteen meat and poultry facilities reporting releases of nitrate compounds to TRI were reviewed as part of the 2011 and 2012 Annual Reviews. EPA determined that the majority of these facilities are in compliance with the ELGs for total nitrogen, or are currently awaiting revised permits that will include total nitrogen permit limitations. As a result, EPA assigned the Meat and Poultry Category a lower priority for revision (U.S. EPA, 2014a). As part of the 2015

Annual Review, EPA determined all facilities reviewed as part of the 2011 and 2012 Annual Reviews also reported nitrate releases to TRI in 2013; however, only eleven are included in the top fifteen facilities listed in Table 3-42.

As part of the 2015 Annual Review, EPA reviewed the 2013 and 2009 TRI nitrate releases for the top 15 facilities listed in Table 3-42. Many of these facilities reported a decrease in nitrate compound releases to TRI from 2009 to 2013. EPA specifically reviewed the five facilities with the greatest increase in nitrate TWPE from 2009 to 2013 (three of which were reviewed previously). Therefore, EPA has focused on the following facilities for the 2015 Annual Review:

- Cargill Meat Solutions Corporation, Schuyler, NE
- Cargill Meat Solutions Corporation, Ottumwa, IA
- John Morrell & Co., Sioux Falls, SD
- Pilgrim's Pride Corporation, Mount Pleasant, TX
- Tyson Farm, Inc., Carthage, MS

Cargill Meat Solutions Corp. (Schuyler, NE)

Cargill Meat Solutions Corporation's facility in Schuyler, NE, is a complex beef slaughterhouse, covered by 40 CFR Part 432, Subcategory B, with a production of approximately 6,500,000 pounds per day in LWK. EPA previously reviewed this facility as part of the 2011 and 2012 Annual Review Reports (U.S. EPA, 2012, 2014a). The facility's nitrate compound releases account for approximately 8 percent of the 2013 TRI nitrate compounds TWPE.[24] Treated process wastewater is discharged via outfalls 001 and 003 to surface water and agricultural land application sites, respectively. Process wastewater discharged to outfall 001 is treated with a dissolved air flotation unit, anaerobic lagoon cells, a four-chambered sequential batch reactor (an activated sludge plant), a chlorine contact basin, and dechlorination. Discharges of nutrient-rich water from outfall 003 (treated process wastewater and non-contact cooling water) are used on agricultural land (the facility does not have an outfall 002) (NE DEQ, 2009).

The facility permit, issued October 2009, includes seasonal limits for ammonia as N for outfalls 001 and 003, which are lower than the effluent limitations specified in 40 CFR Part 432. The permit does not include limits for total nitrogen. The permit writer for Cargill Meat Solutions Corp. stated that the ammonia as N limits were more stringent than the water quality criteria and are based on waste load allocations (Ewoldt, 2012). The ammonia as N permit limits are (NE DEQ, 2009):

- *Winter:* 4.0 mg/L monthly average, 8.0 mg/L daily maximum (equal to BAT limitations).
- *Spring:* 2.58 mg/L monthly average, 5.17 mg/L daily maximum.
- *Summer:* 1.89 mg/L monthly average, 3.79 mg/L daily maximum.

[24] Cargill Meat Solutions in Schuyler, NE, accounted for 6 percent of the 2009 TRI nitrate compound TWPE (U.S. EPA, 2012).

Cargill Meat Solutions Corp. (Ottumwa, IA)

Cargill Meat Solutions, Corp. (Cargill Ottumwa) in Ottumwa, IA, is a hog slaughterhouse. Treated process wastewater is discharged via outfall 001 to the Des Moines River. The treatment for process wastewater discharged through outfall 001 consists of grit removal, settling, chlorination, and an oxidation ditch. Non-contact cooling water from refrigeration and processing equipment is discharged via outfall 002. Wastewater from the facility's third outfall, outfall 801, is a combined waste stream from outfalls 001 and 002 (IA DNR, 2009).

The facility permit, issued May 2009, includes total nitrogen permit limits of 134 mg/L monthly average and 194 mg/L daily maximum. The permit includes ammonia as N limits of 4.0 mg/L monthly average and 8.0 mg/L daily maximum. These limits are based on 40 CFR Part 432 (IA DNR, 2009).

John Morrell & Company (Sioux Falls, SD)

As part of the 2015 Annual Review, EPA contacted the South Dakota Department of Environment and Natural Resources (SD DENR). The state confirmed that the John Morrell & Company facility in Sioux Falls, SD, is currently operating under an administratively continued permit which expired March 31, 2005. According to this permit, the facility discharges treated process wastewater via outfall 001 (SD DENR, 2000b).

The facility's 2000 permit does not include total nitrogen limits. The permit includes the following ammonia as N permit limits, which are based on a total maximum daily load based on the background water quality of the Big Sioux River near Sioux Falls, the surface water quality standard for un-ionized ammonia (0.04 mg/L), and best professional judgment. The 30-day average ammonia limits are based on their allocation of the allowable waste load (SD DENR, 2000a; SD DENR, 2000b):

- *Spring (April – May):* 70 lb/day monthly average, 123 lb/day daily maximum.
- *Summer (June – August):* 58 lb/day monthly average, 102 lb/day daily maximum.
- *Fall (September – October):* 75 lb/day monthly average, 131 lb/day daily maximum.
- *Winter (November – March):* 163 lb/day monthly average, 285 lb/day daily maximum.

Table 3-44 presents the John Morrell Sioux Falls facility's ammonia as N 2013 DMR average daily concentration and wastewater flow data for outfall 001. EPA calculated the average quantities using the reported concentrations and wastewater flows, and compared them to the seasonal permit limits for ammonia as N. As shown, the 2013 ammonia as N discharges are below the allowable period load based on the permit limits.

Table 3-44. John Morrell's Sioux Falls Facility's 2013 DMR Discharges for Ammonia as N, Outfall 001

Monitoring Period End Date	Wastewater Flow (MGD)	Average Daily Concentration (mg/L)	Calculated Average Quantity (lb/day)	NPDES Monthly Average Permit Limit (lb/day)
31-Jan-13	2.17	1.13	20.5	163

Table 3-44. John Morrell's Sioux Falls Facility's 2013 DMR Discharges for Ammonia as N, Outfall 001

Monitoring Period End Date	Wastewater Flow (MGD)	Average Daily Concentration (mg/L)	Calculated Average Quantity (lb/day)	NPDES Monthly Average Permit Limit (lb/day)
28-Feb-13	2.19	1.05	19.2	163
31-Mar-13	2.14	0.91	16.3	163
30-Apr-13	2.16	0.94	16.9	70
31-May-13	2.17	0.86	15.6	70
30-Jun-13	2.29	0.88	16.8	58
31-Jul-13	2.14	0.72	12.9	58
31-Aug-13	2.33	0.67	13.0	58
30-Sep-13	2.26	0.72	13.6	75
31-Oct-13	2.03	0.80	13.6	75
30-Nov-13	2.14	0.77	13.8	163
31-Dec-13	2.02	1.12	18.9	163

Source: DMR Loading Tool; SD DENR, 2000b for permit limits
Note: Rounding of calculated limits may mean actual monitoring period loads vary slightly.

Pilgrim's Pride Corp. (Mount Pleasant, TX)

Pilgrim's Pride Corp – Mt Pleasant Complex, in Mount Pleasant, TX, is a poultry first processing plant covered by 40 CFR Part 432, Subcategory K. EPA previously reviewed this facility as part of the 2011 and 2012 Annual Review Reports (U.S. EPA, 2012 and 2014a). The facility's permit, which was recently under a major amendment change since the 2012 Annual Review, includes limits for total nitrogen and seasonal limits for ammonia as N. According to the facility permit, the facility discharges treated process wastewater via outfall 001. The process wastewater is treated by primary and secondary screening for solids removal, flow equalization, dissolved air flotation with chemical addition, biotower treatment, two activated sludge aeration basins, two final clarifiers, sand filtration, chlorination, and dechlorination (TCEQ, 2015).

The total nitrogen permit limits are based on 40 CFR Part 432 and are 103 mg/L monthly average, 147 mg/L daily maximum. The ammonia as N permit limits are based on water quality criteria and equal to 40 CFR Part 432. They are (TCEQ, 2015):

- *Winter:* 4.0 mg/L monthly average, 8.0 mg/L daily maximum.
- *Summer:* 1.0 mg/L monthly average, 2.0 mg/L daily maximum.

Tyson Farms, Inc. (Carthage, MS)

Tyson Farms, Inc., Carthage Processing Plant in Carthage, MS, is a poultry first processor covered by 40 CFR Part 432, Subcategory K. The facility discharges treated process and sanitary wastewater, as well as non-contact cooling water, from outfall 001 into Cobbs Creek via Pickens Branch (MDEQ, 2010a). The facility's treatment process includes screens, anaerobic lagoons, activated sludge, sedimentation, disinfection, and dechlorination (MDEQ, 2010b).

The total nitrogen permit limits are based on 40 CFR Part 432 and are 103 mg/L monthly average, 147 mg/L daily maximum. The ammonia as N permit limits are not seasonally based and are 2.0 mg/L monthly average, 3.0 mg/L daily maximum (MDEQ, 2010a).

Nitrate Compounds Discharge Summary

EPA has determined the following for the top 2013 TRI nitrate compound dischargers:

- The total TRI nitrate compound TWPE decreased from 2009 to 2013; however, for seven of the top fifteen facilities the TRI nitrate compound TWPE increased during this period. Further five of the top seven facilities reported an increase of 20 percent or more, as shown in Table 3-42. As Table 3-45 shows, three of the five facility permits further reviewed as part of the 2015 Annual Review are in compliance with 40 CFR Part 432 total nitrogen limitations. One permit is currently under revision and is expected to include total nitrogen limits. EPA determined that one facility (Cargill Meat Solutions, in Schuyler, NE), while likely captured in the applicability of 40 CFR Part 432, Subcategory B, does not include total nitrogen limits (the ELGs specify total nitrogen limits). The ammonia as N limits included in this facility's permit are more stringent than 40 CFR Part 432 for ammonia.

Table 3-45. Findings for Select 2013 TRI Nitrate Compound Dischargers

Facility Name	State	Subpart	Date Permit Issued	40 CFR Part 432 Total Nitrogen Max Daily (mg/L)	40 CFR Part 432 Total Nitrogen Max Monthly Average (mg/L)	EPA Findings
Cargill Meat Solutions	NE	B	October 2009	NA	NA	Permit limits are more stringent than 40 CFR Part 432 for ammonia; however, permit does not include total nitrogen limits.
Cargill Meat Solutions	IA	ND	May 2009	194	134	Permit limits based on 40 CFR Part 432 total nitrogen and ammonia limitations.
John Morrell & Co.	SD	ND	April 2000	NA	NA	Facility is operating under an administratively continued permit, which is currently under revision. ELGs were not incorporated into existing permit since it was issued prior to the effective date of the ELG.
Pilgrim's Pride Corp.	TX	K	June 2015	147	103	Total nitrogen permit limits based on 40 CFR Part 432 limitations. Ammonia permit limits based on water quality criteria equal to 40 CFR Part 432 limitations.
Tyson's Farm, Inc.	MS	K	December 2010	147	103	Permit limits based on 40 CFR Part 432 total nitrogen limitations.

Sources: IA DNR, 2009; NE DEQ, 2009; SD DEQ, 2000b; TCEQ, 2015; and MDEQ, 2010a.
NA = Not applicable
ND = Not determined

3.6.4 Meat and Poultry Category Hydrogen Sulfide Releases in TRI

EPA's investigation of the hydrogen sulfide releases revealed that four facilities account for 93 percent of the 2013 TRI hydrogen sulfide releases (shown in Table 3-46). EPA did not investigate the remaining facilities discharging hydrogen sulfide as part of the 2015 Annual Review.

Table 3-46. Top Facilities Reporting 2013 TRI Hydrogen Sulfide Releases

Facility Name	Facility Location	Pounds of Pollutant Released	Pollutant TWPE	Percent of Category TWPE
Tyson Fresh Meats, Inc.	Hillsdale, IL	5,320	14,900	39.5%
Tyson Fresh Meats, Inc.	Lexington, NE	3,350	9,380	24.9%
Tyson Fresh Meats, Inc.	Columbus Junction, IA	2,220	6,220	16.5%
John Morrell & Co.	Sioux Falls, SD	1,600	4,490	11.9%
All other hydrogen sulfide releases in the Meat and Poultry Category[a]		986	2,760	7.3%
Total		**13,500**	**37,700**	**100%**

Source: *TRILTOutput2013_v1*.
Note: Sums of individual values may not equal the total presented, due to rounding.
a Seven additional facilities reported hydrogen sulfide releases in the 2013 TRI.

Hydrogen sulfide discharges from meat and poultry facilities result from the anaerobic treatment of process wastewater. Anaerobic treatment is advantageous for treating wastewater from meat and poultry facilities because it requires low levels of energy to digest the high concentration of organic solid fractions of animal by-products from slaughterhouse facilities. Anaerobic lagoons are a common form of wastewater treatment. The degradation of the organic material typically emits methane and carbon dioxide; ammonium and hydrogen sulfide are also produced in trace amounts. The pH of the wastewater determines the composition of air emissions; for example, a pH lower than 6 produces more hydrogen sulfide and carbon dioxide emissions. Covering the lagoons improves heat retention, though a layer of scum typically forms on the lagoon surface, even if uncovered, which also reduces heat loss and emissions of malodorous compounds, such as hydrogen sulfide (U.S. EPA, 2002). The Meat and Poultry ELGs do not include limitations and standards for hydrogen sulfide.

Aerobic treatment of process wastewater can also result in hydrogen sulfide emissions. Facultative lagoons combine aerobic and anaerobic degradation, providing an aerobic upper layer and an anaerobic bottom layer, which digests the settleable solids in the wastewater. Though sulfides are created within the anaerobic layer, these emissions are typically oxidized before releasing into the atmosphere (U.S. EPA, 2002).

As discussed in Section 2.2.2.1 and Section 3.3 of this report, EPA announced that it was lifting the 1994 Administrative Stay of the reporting requirements for hydrogen sulfide on October 17, 2011 (76 FR 64022). Facilities were required to report environmental releases of hydrogen sulfide to TRI beginning with the reporting year 2012, including releases to water. EPA did not perform a TRA in 2014; therefore, EPA is reviewing hydrogen sulfide discharges for the first time as part of the 2015 Annual Review. EPA is focusing on hydrogen sulfide releases reported by direct dischargers in the 2013 TRI.

As part of the 2015 Annual Review, EPA contacted the four facilities presented in Table 3-46 to determine how they are calculating hydrogen sulfide releases. Because only two parent companies own the four facilities in Table 3-46, EPA summarized the findings by parent company in the following sub-sections.

Tyson Fresh Meats, Inc.

The facilities located in Hillsdale, IL, Lexington, NE, and Columbus Junction, IA, are all direct dischargers and employ different wastewater treatment techniques, as summarized in Table 3-47. The Hillsdale and Lexington facilities are complex beef slaughterhouses (IL EPA, 2011; NE DEQ, 2010). The facility in Columbus Junction is a complex hog slaughterhouse (Heeb, 2015). The company contact stated that hydrogen sulfide concentrations are generally similar between facilities (Dirks, 2014).

Table 3-47. Wastewater Treatment Steps at Various Tyson Fresh Meats, Inc. Facilities

Wastewater Treatment Steps	Hillsdale, IL	Columbus Junction, IA	Lexington, NE
Anaerobic lagoon (covered)	X		X
Anaerobic lagoon (uncovered)		X	
Biogas handling	X		X
Anoxic process	X		X
Aeration process	X	X	X
Secondary clarification	X	X	X
Chlorination	X	X	X
Dechlorination	X	X	X
Discharge to stream	X	X	X

Source: Dirks, 2014.

The three facilities have similar procedures for estimating their hydrogen sulfide releases. The facilities use limited samples of soluble sulfide and pH, in addition to known proportions of hydrogen sulfide and hydrosulfide ion in dissolved sulfide (assuming a neutral solution), to convert this sulfide concentration into hydrogen sulfide. The amount of hydrogen sulfide, in pounds, is estimated using a conversion based on the wastewater flow and calculated hydrogen sulfide concentration. The TRI reported releases are not a result of direct sampling of hydrogen sulfide at any of the three facilities (Dirks, 2014).

In an effort to further understand the reported releases of hydrogen sulfide to TRI, EPA reviewed available DMR data for the Hillsdale and Lexington facilities, however, neither facility's permit limits or requires monitoring for hydrogen sulfide. The Columbus Junction facility permit is still under review due to a Use Attainability Analysis (UAA) concerning the receiving stream, therefore, the facility only has TRI data available (Heeb, 2015).

John Morrell & Co.

John Morrell & Company's facility in Sioux Falls, SD, reported direct releases of hydrogen sulfide to TRI in 2013 based on published emission factors (i.e., basis of estimate code E1). As part of the 2015 Annual Review, EPA contacted the facility and confirmed that the TRI hydrogen sulfide releases are estimated from treatment processes at the facility based on calculations using collection efficiencies and emission factors developed at the facility (Schulz, 2014). Therefore, the TRI reported releases are not a result of direct sampling. EPA reviewed available DMR data for this facility and determined that the facility's discharge permit does not limit or require monitoring of hydrogen sulfide.

Hydrogen Sulfide Discharge Summary

Based on company contacts, EPA determined that three facilities estimated their hydrogen sulfide releases reported to TRI based on soluble sulfide sampling data. The company contact for these facilities stated that this approach likely accurately represents potential releases to surface waters as reported to TRI. A fourth facility reviewed used emission factors to estimate their reported hydrogen sulfide releases. These four facilities account for 93 percent of the hydrogen sulfide releases reported to TRI in 2013.

3.6.5 Meat and Poultry Category Findings

The estimated toxicity of the Meat and Poultry Category discharges resulted primarily from nitrate compound and hydrogen sulfide releases reported to TRI. From the 2015 Annual Review, EPA found:

- ***Nitrate.*** Fifteen meat and poultry facilities account for the majority of TRI nitrate compound releases. EPA previously reviewed many of these in recent annual reviews. For the 2015 Annual Review, EPA focused its review on five facilities whose nitrate compound TWPE increased from 2009 to 2013. Three of these facility permits are in compliance with current total nitrogen ELGs. One permit is currently under revision and is expected to include total nitrogen limitations specified in the ELGs. EPA determined that one facility is likely captured in the applicability of 40 CFR Part 432, Subcategory B; however, the permit does not include total nitrogen limitations. The ammonia as N limitations included in this facility's permit are more stringent than local water quality criteria.
- ***Hydrogen Sulfide.*** Four facilities accounted for the majority of the hydrogen sulfide releases. All four facilities reported direct releases of hydrogen sulfide to TRI. Three of the four facilities are estimating their hydrogen sulfide releases by using soluble sulfide sampling data collected at the facilities. A company contact for three of the facilities believes that the direct releases of hydrogen sulfide they report to TRI accurately represent potential releases to receiving waters. EPA determined that the other facility is using published emission factors, and not direct wastewater sampling, to estimate hydrogen sulfide releases. EPA is uncertain as to how representative the data are of actual releases.

3.6.6 Meat and Poultry Category References

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3.7 Mineral Mining and Processing (40 CFR Part 436)

EPA identified the Mineral Mining and Processing (Mineral Mining) Category for preliminary review because it ranks high again, in terms of toxic-weighted pound equivalents (TWPE), in the final 2015 combined point source category rankings. Previously, EPA reviewed discharges from this category as part of the 2004, 2010, and 2011 Annual Reviews in which it also ranked high (U.S. EPA, 2004, 2011, 2012). This section summarizes the results of the 2015 Annual Review. EPA focused its 2015 review on discharges of chloride, aluminum, and fluoride because of their high TWPE relative to the other pollutants discharged by facilities in the Mineral Mining Category. Fluoride, reviewed as part of the 2010 and 2011 Annual Reviews, continued to be a top pollutant of concern. For the 2015 Annual Review, available discharge data also showed significant contributions of chloride and aluminum.

3.7.1 Mineral Mining Category 2015 Toxicity Rankings Analysis

Table 3-48 compares the toxicity rankings analyses (TRA) data for the Mineral Mining Category from the 2011, 2013, and 2015 Annual Reviews. EPA did not conduct the TRA in 2012 or 2014, but instead reviewed additional data sources as part of the even-year annual review, as described in Section 2.2.1 of EPA's Preliminary 2016 Plan (U.S. EPA, 2016). During the 2015 Annual Review, EPA did not identify any data corrections to the 2013 Discharge Monitoring Report (DMR) and Toxic Release Inventory (TRI) discharge data for the Mineral Mining Category.

Table 3-48. Mineral Mining Category TRI and DMR Facility Counts and Discharges Reported in 2009, 2011, and 2013

Year of Discharge	Year of Review	Mineral Mining Category Facility Counts[a]			Mineral Mining Category TWPE		
		Total TRI Facilities	Total DMR Major Facilities	Total DMR Minor Facilities	TRI TWPE[b]	DMR TWPE[c]	Total TWPE
2009	2011	91	26	113	5,430	44,700[d]	50,100[d]
2011	2013	82	20	127	2,950	31,200	34,100
2013	2015	81	9	76	4,710	139,000	144,000

Sources: *TRIReleases2009_v2, DMRLoads2009_v2,* and 2011 Annual Review Report (for 2009 DMR and TRI data) (U.S. EPA, 2012); *DMRLTOutput2011_v1* (for 2011 DMR); *TRILTOutput2011_v1* (for 2011 TRI); *DMRLTOutput2013_v1* (for 2013 DMR); *TRILTOutput2013_v1* (for 2013 TRI)

Note: EPA did not evaluate 2010 or 2012 DMR and TRI data.

Note: TWPE values are rounded to three significant figures. Sums of individual values may not equal the total presented, due to rounding.

a Number of facilities with TWPE greater than zero.

b Releases include direct releases to surface waters and transfers to POTWs. Transfers to POTWs account for POTW removals.

c Includes DMR data from both major and minor dischargers.

d 2009 data after corrections were made during the 2011 Annual Review.

As shown in Table 3-48, the DMR and total TWPE decreased from 2009 to 2011 and increased significantly from 2011 to 2013. The number of TRI facilities decreased from 2009 to 2013, while the total number of DMR facilities increased slightly from 2009 to 2011 but then decreased substantially from 2011 to 2013. The increase in TWPE from 2011 to 2013 is primarily due to discharges from the facilities described in the sections below. The decrease in the number of facilities from 2011 to 2013 is due to decreases in minor facilities in two states, Colorado and Ohio (DMR Loading Tool).

3.7.2 Mineral Mining Category Pollutants of Concern

EPA's 2015 review of the Mineral Mining Category focused on the 2013 DMR discharges because the DMR data dominate the category's combined TWPE. Table 3-49 shows the five pollutants with the highest contribution to the 2013 DMR TWPE. As a point of comparison, Table 3-49 shows the 2011 DMR facility count and TWPE for these top five pollutants, based on the 2013 Annual Review (U.S. EPA, 2014).

Chloride, aluminum, and fluoride contribute more than 81 percent of the total 2013 DMR TWPE. Of these top pollutants, only fluoride is a regulated pollutant in the Mineral Mining Category effluent limitations guidelines and standards (ELGs) (40 CFR Part 436). EPA's investigations of reported discharges of the top three pollutants are presented in Sections 3.7.3 and 3.7.4. EPA did not investigate the other pollutants, including iron and cyanide, as part of the 2015 Annual Review, because they represent a small percentage (11 percent) of the 2013 DMR TWPE for the Mineral Mining Category.

Table 3-49. Mineral Mining Category Top DMR Pollutants

Pollutant[b]	2013 DMR Data[a]		2011 DMR Data[a]	
	Number of Facilities Reporting Pollutant[c]	TWPE	Number of Facilities Reporting Pollutant[c]	TWPE
Chloride	21	45,900	25	8,990
Aluminum	12	45,200	15	3,080
Fluoride	13	21,700	14	11,500
Iron	17	8,150	36	580
Cyanide	4	7,670	6	523
Top Pollutant Total	**NA**	**129,000**	**NA**	**24,700**
Mineral Mining Category Total	**85**	**139,000**	**147**	**31,200**

Sources: *DMRLTOutput2013_v1* (for 2013 TWPE); *DMRLTOutput2011_v1* (for 2011 TWPE).
NA: Not applicable.
a Includes DMR data from both major and minor dischargers.
b Iron and cyanide discharges combined contribute 11 percent of the 2013 category DMR TWPE. Therefore, EPA did not review iron or cyanide discharges as part of the 2015 Annual Review.
c Number of facilities with TWPE greater than zero.

3.7.3 Mineral Mining Category Chloride and Aluminum Discharges in DMR

EPA's investigation of chloride discharges revealed that two facilities, SES Assets LLC (formerly Lambert Dock) in Belmont, WV, and Cedar Lake Plant in Seagraves, TX, account for 96 percent of the 2013 DMR chloride discharges (shown in Table 3-50). In addition, EPA's investigation of the aluminum discharges revealed that SES Assets LLC in Belmont, WV, also accounts for 95 percent of the 2013 DMR aluminum discharges (shown in Table 3-51). Because

SES Assets accounts for the majority of both the chloride and aluminum discharges, these discharges are reviewed together in this section. EPA did not investigate the remaining facilities discharging chloride or aluminum as part of the 2015 Annual Review.

Table 3-50. Top 2013 DMR Chloride Discharging Facilities

Facility Name	Facility Location	Pounds of Pollutant Discharged	Pollutant TWPE	Percent of Category TWPE
SES Assets LLC (formerly Lambert Dock)	Belmont, WV	1,380,000,000	33,600	73%
Cedar Lake Plant	Seagraves, TX	429,000,000	10,400	23%
All other chloride dischargers in the Mineral Mining Category[a]		75,900,000	1,850	4%
Total		**1,880,000,000**	**45,900**	**100%**

Source: *DMRLTOutput2013_v1*.
Note: Sums of individual values may not equal the total presented, due to rounding.
[a] 19 additional facilities submitted chloride discharges in the 2013 DMR data.

Table 3-51. Top 2013 DMR Aluminum Discharging Facilities

Facility Name	Facility Location	Pounds of Pollutant Discharged	Pollutant TWPE	Percent of Category TWPE
SES Assets LLC (formerly Lambert Dock)	Belmont, WV	717,000	43,000	95%
All other aluminum dischargers in the Mineral Mining Category[a]		36,100	2,160	5%
Total		**753,000**	**45,200**	**100%**

Source: *DMRLTOutput2013_v1*.
Note: Sums of individual values may not equal the total presented, due to rounding.
[a] 11 additional facilities submitted aluminum discharges in the 2013 DMR data.

SES Assets, LLC (Chloride and Aluminum Discharges)

SES Assets LLC (formerly Lambert Dock), in Belmont, WV, discharges chloride and aluminum through three outfalls. SES is a sand and gravel hauling facility that has large salt piles on site. As part of the 2015 Annual Review, EPA contacted the facility about their chloride and aluminum discharges. The facility contact confirmed the 2013 chloride and aluminum discharges and explained that the discharges are from surface runoff from the large contaminated salt piles that SES Assets inherited from Lambert Trucking in 2010. The salt is stored onsite and sold to the West Virginia Department of Transportation for winter road use. The piles have been onsite since the 1970s and are located near outfall 002 and 003. Table 3-52 presents the 2011 through 2014 DMR chloride and aluminum discharges for SES Assets, LLC. After SES Assets acquired the facility in 2010, stricter reporting was enforced (Goble, 2014). Previously, before the acquisition, the facility did not submit consistent DMR data.

Table 3-52. SES Assets, LLC Chloride and Aluminum Discharges for 2011 – 2014

Year of Discharge	Chloride TWPE	Aluminum TWPE
2011	636	2,810
2012	44,200	20,600
2013	33,600	43,000
2014	2,500	1,390

Source: DMR Loading Tool

The facility contact indicated that over the last two years the company has implemented remediation efforts on site, such as salt storage pad berm repair and repair of outfalls 002 and 003 (Goble, 2014). This is reflected in the decreased chloride and aluminum TWPE from 2013 to 2014, shown in Table 3-52. However, the facility contact stated that the company is selling their remaining salt piles and does not plan to store salt on site in the future (Goble, 2014). EPA expects the discharges from this facility to decrease in future years.

Cedar Lake Plant (Chloride Discharges)

Cedar Lake Plant, owned by Cooper Natural Resources Inc., in Seagraves, TX, discharges chloride through two outfalls, 001 and 003. The facility produces anhydrous sodium sulfate from brine extracted from Cedar Lake, a saline lake. Spent brine is returned to the lake via outfall 001, along with plant floor wash water, condensate from evaporation processes, and stormwater. Wastewater from pump house floor washdown, booster pump noncontact cooling water, stormwater, and occasional brine tank overflow are all discharged through outfall 002. EPA did not review DMR data from outfall 002 as part of this review because the outfall does not have chloride discharges. Cooling tower blowdown from the evaporation pond, intermittent brine tank overflow, stormwater runoff, culvert wash water, and tank washdown are discharged through outfall 003. Because the facility withdraws and discharges to Cedar Lake, 40 CFR 436.122(b) allows net limitations to be applied (TCEQ, 2009). Therefore, there are no reportable limits for TDS, chloride, or sulfate; rather the wastewater discharge may not fall below the quality of the water withdrawn (TCEQ, 2009).

Chloride is not a regulated pollutant in the Mineral Mining Category ELGs. Historical discharge data to support the no reportable limits in Cedar Lake's permit are provided in the Statement of Basis/Technical Summary for the facility (TCEQ, 2009). The facility's permit expired on December 1, 2014 and an updated permit and Statement of Basis/Technical Summary have been drafted (TCEQ, 2015). Table 3-53 presents the average monthly flow and chloride discharges for all three outfalls from 2004 through 2009 and 2009 through 2014 as presented in the Statement of Basis/Technical Summary documents (TCEQ, 2009 and TCEQ, 2015). EPA compared these discharges to the 2013 DMR average monthly discharges for outfalls 001 and 002 in Table 3-53 to show that they are consistent with those presented in the Statement of Basis/Technical Summary documents from TCEQ.

Table 3-53. Cedar Lake Plant's Historical and 2013 DMR Monthly Chloride Discharges

	Outfall 001		Outfall 002		Outfall 003	
	Flow (MGD)	Chloride Concentration (mg/L)	Flow (MGD)	Chloride Concentration (mg/L)	Flow (MGD)	Chloride Concentration (mg/L)
Average Monthly Discharge, 2004 – 2009						
2004-2009 Average of Daily Avg[a]	1.06	92,968	0.026	26,822	0.027	52,316
2004-2009 Maximum of Daily Max[b]	1.58	116,886	0.28	95,497	0.06	97,746
Average Monthly Effluent, 2009 – 2014						
2009-2014 Average of Daily Avg[a]	1.259	93,769	No discharge reported		0.148	66,857
2009-2014 Maximum of Daily Max[b]	1.575	166,000			1.305	211,000
Average Daily Discharge, 2013 DMR Data						
31-Jan-13	1.305	104,225	No discharge reported		0.012	68,450
28-Feb-13	1.305	95,050			0.012	78,300
31-Mar-13	1.305	98,400			0.011	87,900
30-Apr-13	1.305	89,160			0.1	70,367
31-May-13	1.305	104,950			0.015	77,250
30-Jun-13	1.27	91,950			0.022	44,800
31-Jul-13	1.305	127,400			0.007	30,850
31-Aug-13	1.305	104,175			0.013	54,275
30-Sep-13	1.305	120,175			0.012	93,067
31-Oct-13	1.305	109,733			0.012	57,233
30-Nov-13	1.305	128,800			0.005	130,000
31-Dec-13	1.305	110,750			0	0

Source: TCEQ, 2009; TCEQ, 2015; *DMRLTOutput2013_v1*.

[a] Average of Daily Avg values are the average of all daily average values for the reporting period.

[b] Maximum of Daily Max values are the individual maximum values for the reporting period.

Table 3-53 shows that the 2013 DMR discharges are similar in magnitude to discharges used to determine the no reportable limit in the facility's permit. Additionally, as noted above, the facility withdraws and discharges to Cedar Lake allowing net limitations to be applied.

3.7.4 Mineral Mining Category Fluoride Discharges in DMR

EPA's investigation of the fluoride discharges revealed that PCS Phosphate White Springs, in White Springs, FL, accounts for 69 percent of the 2013 DMR fluoride discharges (shown in Table 3-54). EPA did not investigate the remaining 12 facilities discharging fluoride as part of the 2015 Annual Review.

Table 3-54. Top 2013 DMR Fluoride Discharging Facilities

Facility Name	Facility Location	Pounds of Pollutant Discharged	Pollutant TWPE	Percent of Category TWPE
PCS Phosphate White Springs	White Springs, FL	496,000	14,900	69%
All other fluoride dischargers in the Mineral Mining Category[a]		226,000	6,770	31%
Total		**722,000**	**21,700**	**100%**

Source: *DMRLTOutput2013_v1*.
Note: Sums of individual values may not equal the total presented, due to rounding.
[a] 12 additional facilities submitted fluoride discharges in the 2013 DMR data.

PCS Phosphate White Springs generates wastewater from open-pit mining of phosphate rock, beneficiation of the rock, manufacture of sulfuric acid and phosphoric acid, production of fertilizer components and animal-feed supplements, and stormwater runoff. The facility's treatment system includes pH adjustment and chemical precipitation using lime; settling and sedimentation; and adsorption/absorption on mining waste clay particles in clay settling areas (FL DEP, 2013).

PCS Phosphate White Springs discharges fluoride from outfalls 001, 002, 003, and 004. All four outfalls have a monthly average reporting requirement for fluoride and a daily maximum permit limit of 10 mg/L (FL DEP, 2013). Table 3-55 presents the average monthly flows and fluoride discharge concentrations for three outfalls in 2013; the facility reported no discharges from outfall 003 in 2013. There are multiple internal outfalls that feed into 001, so the facility samples at a point in Swift Creek where 001 discharges. None of the fluoride concentrations, shown in Table 3-55, exceed the daily maximum permit limit. As part of the 2015 Annual Review, EPA contacted the Florida Department of Environmental Protection (FL DEP), which confirmed the facility's 2013 fluoride discharges (FL DEP, 2015).

Table 3-55. PCS Phosphate White Spring's 2013 DMR Monthly Average Fluoride Discharges

	Outfall 001		Outfall 002		Outfall 004	
Date	Flow (MGD)	Fluoride Concentration (mg/L)	Flow (MGD)	Fluoride Concentration (mg/L)	Flow (MGD)	Fluoride Concentration (mg/L)
31-Jan-13	25.0	2.3	1.1	0.6	0.9	0.7
28-Feb-13	30.4	1.6	1.0	1.2	3.3	0.6
31-Mar-13	59.4	1.9	1.0	3.0	2.9	0.8
30-Apr-13	65.7	2.1	1.0	3.9	4.5	0.9
31-May-13	53.3	2.9	1.4	5.0	6.0	1.1
30-Jun-13	99.9	2.5	0.9	5.6	5.5	0.9
31-Jul-13	144	2.3	0.8	9.0	18.9	0.9
31-Aug-13	90.9	2.7	0.8	3.2	5.2	0.9
30-Sep-13	72.4	2.5	0.8	1.9	1.5	0.7
31-Oct-13	33.8	2.9	0.0	0.0	0.9	0.7

Table 3-55. PCS Phosphate White Spring's 2013 DMR Monthly Average Fluoride Discharges

	Outfall 001		Outfall 002		Outfall 004	
Date	Flow (MGD)	Fluoride Concentration (mg/L)	Flow (MGD)	Fluoride Concentration (mg/L)	Flow (MGD)	Fluoride Concentration (mg/L)
30-Nov-13	25.4	3.0	0.0	0.0	1.8	1.0
31-Dec-13	52.2	3.2	0.8	1.1	4.2	1.1

Source: *DMRLTOutput2013_v1*

Table 3-56 presents PCS Phosphate White Spring's total fluoride discharges from 2011 through 2014. As shown, discharges have increased from 2011 to 2014, almost doubling between 2013 and 2014.

Table 3-56. PCS Phosphate White Spring's Fluoride Discharges for 2011 – 2014

Year of Discharge	Fluoride TWPE
2011	5,570
2012	12,100
2013	14,900
2014	27,200

Source: DMR Loading Tool

3.7.5 Mineral Mining Category Findings

The estimated toxicity of the Mineral Mining Category discharges resulted primarily from chloride, aluminum, and fluoride discharges reported on DMRs. From the 2015 Annual Review, EPA found:

- ***Chloride and Aluminum.*** SES Assets, (formerly Lambert Dock) in Belmont, WV, and Cedar Lake Plant, in Seagraves, TX, account for 96 percent of the 2013 DMR chloride discharges. SES Assets also accounts for 95 percent of the 2013 DMR aluminum discharges.
  - SES Assets' chloride and aluminum discharges can be attributed to the large salt piles the facility has on site. SES Assets has implemented remediation efforts, is selling its remaining salt piles, and does not plan to store salt on site in the future. For this reason, EPA does not consider these discharges to be representative of the Mineral Mining Category.
  - Cedar Lake Plant has net limitations because they withdraw from and discharge to the same saline body of water. Additionally, chloride concentrations have been consistent from 2004 through 2013. For these reasons, EPA does not consider these discharges to be representative of the Mineral Mining Category.
- ***Fluoride.*** One facility, PCS Phosphate White Springs in White Springs, FL, contributed 69 percent of the 2013 DMR fluoride discharges. The facility's discharges have increased from 2011 to 2014.

3.7.6 Mineral Mining Category References

1. ERG. 2015. Preliminary Category Review – Facility Data Review for Point Source Category – 436 – Mineral Mining and Processing. (September). EPA-HQ-OW-2015-0665. DCN 08162.

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11. U.S. EPA. 2016. *Preliminary 2016 Effluent Guidelines Program Plan.* Washington, D.C. (June). EPA-821-R-16-001. EPA-HQ-OW-2015-0665. DCN 08208.

3.8 Nonferrous Metals Manufacturing (40 CFR Part 421)

EPA identified the Nonferrous Metals Manufacturing (NFMM) Category for preliminary review because it ranks high again, in terms of toxic-weighted pound equivalents (TWPE), in the final 2015 combined point source category rankings. Previously, EPA reviewed discharges from this category as part of the 2004, 2006, 2007, 2009, 2011, and 2013 Annual Reviews in which it also ranked high (U.S. EPA, 2004, 2006, 2007, 2009, 2012, 2014). This section summarizes the results of the 2015 Annual Review. EPA focused its 2015 review on discharges of cadmium and fluoride because of their high TWPE relative to the other pollutants discharged by facilities in the NFMM Category. Cadmium, reviewed as part of the 2013 Annual Review, continues to be a top pollutant of concern. For the 2015 Annual Review, available discharge data also showed significant contributions of fluoride.

3.8.1 NFMM Category 2015 Toxicity Rankings Analysis

Table 3-57 compares the toxicity rankings analyses (TRA) data for the NFMM Category from the 2011, 2013, and 2015 Annual Reviews. EPA did not conduct the TRA in 2012 or 2014, but instead reviewed additional data sources as part of the even-year annual review, as described in Section 2.2.1 of EPA's Preliminary 2016 Plan (U.S. EPA, 2016). During the 2015 Annual Review, EPA did not identify any data corrections to the 2013 Discharge Monitoring Report (DMR) and Toxic Release Inventory (TRI) discharge data for the NFMM Category.

Table 3-57. NFMM Category TRI and DMR Facility Counts and Discharges Reported for 2009, 2011, and 2013

Year of Discharge	Year of Review	NFMM Category Facility Counts[a]			NFMM Category TWPE		
		Total TRI Facilities	Total DMR Major Facilities	Total DMR Minor Facilities	TRI TWPE[b]	DMR TWPE[c]	Total TWPE
2009	2011	121	29	19	40,500	160,000[d]	201,000[d]
2011	2013	119	28	23	42,900	330,000[e]	373,000[e]
2013	2015	108	18	11	34,300	187,000	221,000

Sources: 2013 Annual Review Report (for 2009 and 2011 DMR and TRI data) (U.S. EPA, 2014); *DMRLTOutput2013_v1* (for 2013 DMR); *TRILTOutput2013_v1* (for 2013 TRI)
Note: EPA did not evaluate 2010 or 2012 DMR and TRI data.
Note: TWPE values are rounded to three significant figures. Sums of individual values may not equal the total presented, due to rounding.
a Number of facilities with TWPE greater than zero.
b Releases include direct discharges to surface waters and transfers to POTWs. Transfers to POTWs account for POTW removals.
c Includes DMR data from both major and minor dischargers.
d 2009 data after corrections were made during the 2011 Annual Review.
e 2011 data after corrections were made during the 2013 Annual Review.

As shown in Table 3-57, the total TWPE increased from 2009 to 2011 and decreased from 2011 to 2013. Additionally, the number of TRI facilities decreased from 2009 to 2013, while the total number of DMR facilities increased from 2009 to 2011, then decreased significantly from 2011 to 2013.

3.8.2 NFMM Category Pollutants of Concern

EPA's 2015 review of the NFMM Category focused on the 2013 DMR discharges because the DMR data dominate the category's combined TWPE. Table 3-58 shows the five pollutants with the highest contribution to the 2013 DMR TWPE. As a point of comparison, Table 3-58 shows the 2011 DMR facility count and TWPE for these top five pollutants, based on the 2013 Annual Review (U.S. EPA, 2014).

Cadmium and fluoride contribute more than 78 percent of the total 2013 DMR TWPE. Cadmium and fluoride are regulated in the NFMM Category effluent limitations guidelines and standards (ELGs) (40 CFR Part 421). EPA's investigations of reported discharges of these pollutants are presented in Section 3.8.3. EPA did not investigate the other pollutants, including zinc, lead, and aluminum, as part of the 2015 Annual Review, because they represent a small percentage (13 percent) of the 2013 DMR TWPE for the NFMM Category.

Table 3-58. 2013 NFMM Category Top DMR Pollutants

Pollutant[b]	2013 DMR Data[a]		2011 DMR Data[a]	
	Number of Facilities Reporting Pollutant[c]	TWPE	Number of Facilities Reporting Pollutant[c]	TWPE[d]
Cadmium	4	104,000	9	114,000
Fluoride	15	41,100	18	18,100
Zinc	17	8,990	29	9,910
Lead	11	8,420	20	19,400
Aluminum	16	7,680	22	12,400
Top Pollutant Total	**NA**	**170,000**	**NA**	**174,000**
NFMM Category Total	**29**	**187,000**	**51**	**330,000**

Sources: *DMRLTOutput2013_v1* (for 2013 TWPE); *DMRLTOutput2011_v1* (for 2011 TWPE)
Note: Sums of individual values may not equal the total presented, due to rounding.
NA: Not applicable.
[a] Includes DMR data from both major and minor dischargers.
[b] Zinc, lead, and aluminum discharges combined contribute 13 percent of the 2013 category DMR TWPE. Therefore, EPA did not review zinc, lead, or aluminum discharges as part of the 2015 Annual Review.
[c] Number of facilities with TWPE greater than zero.
[d] 2011 data after corrections were made during the 2013 Annual Review.

3.8.3 NFMM Cadmium and Fluoride Discharges in DMR

EPA's investigation of the cadmium discharges revealed that one facility, Nyrstar Clarksville, Inc. (Nyrstar), in Clarksville, TN, accounts for over 99 percent of the 2013 DMR cadmium discharges (shown in Table 3-59). In addition, EPA's investigation of the fluoride discharges revealed that two facilities, Nyrstar, in Clarksville, TN, and Horsehead Corp. in Monaca, PA, account for 87 percent of the 2013 DMR fluoride discharges (shown in Table 3-60). Because Nyrstar accounts for the majority of both the cadmium and fluoride discharges, these discharges are reviewed together in this section. EPA did not investigate the remaining facilities discharging cadmium or fluoride as part of the 2015 Annual Review.

Table 3-59. Top 2013 DMR Cadmium Discharging Facilities

Facility Name	Facility Location	Pounds of Pollutant Discharged	Pollutant TWPE	Percent of Category TWPE
Nyrstar Clarksville, Inc.	Clarksville, TN	4,480	103,000	99.4%
All other cadmium dischargers in the NFMM Category[a]		28.6	661	0.6%
Total		**4,510**	**104,000**	**100%**

Source: *DMRLTOutput2013_v1.*
Note: Sums of individual values may not equal the total presented, due to rounding.
[a] Three additional facilities submitted cadmium discharges in the 2013 DMR data.

Table 3-60. Top 2013 DMR Fluoride Discharging Facilities

Facility Name	Facility Location	Pounds of Pollutant Discharged	Pollutant TWPE	Percent of Category TWPE
Nyrstar Clarksville, Inc.	Clarksville, TN	691,000	20,700	50%
Horsehead Corp.	Monaca, PA	508,000	15,200	37%
All other fluoride dischargers in the NFMM Category[a]		175,000	5,240	13%
Total		**1,370,000**	**41,200**	**100%**

Source: *DMRLTOutput2013_v1.*
Note: Sums of individual values may not equal the total presented, due to rounding.
[a] 13 additional facilities submitted fluoride discharges in the 2013 DMR data.

Nyrstar Clarksville, Inc. (Cadmium and Fluoride Discharges)

Nyrstar in Clarksville, TN, produces zinc metal from beneficiation of zinc concentrate ore by a hydrometallurgical process. As secondary products, this facility also produces cadmium metal, sulfuric acid, and metallurgically valuable byproducts (TN DEC, 2005). EPA reviewed the facility's cadmium discharges as part of the 2011 and 2013 Annual Reviews (U.S. EPA, 2012, 2014). Nyrstar discharges cadmium from outfalls 001, SW3, SW4, and SW5, and fluoride from outfall 001. Outfall 001 discharges treated process wastewater, sanitary wastewater, stormwater, and cooling water (TN DEC, 2011). Outfalls SW3, SW4, and SW5 discharge stormwater runoff from the main production area, materials handling areas, and ancillary facility areas, respectively (Crocker, 2013).

Nyrstar was issued a new permit, which took effect January 2012. The permit set a monthly average cadmium limit of 2.28 pounds per day (lb/day) (1.03 kilograms per day (kg/day)), a daily maximum cadmium limit of 5.29 lb/day (2.4 kg/day), and a fluoride limit of report only for outfall 001. Additionally, the permit set a daily maximum cadmium benchmark concentration[25] of 0.0159 milligrams per liter (mg/L) for outfalls SW3, SW4, and SW5, with a quarterly monitoring requirement (TN DEC, 2011).

Table 3-61 presents Nyrstar's 2013 cadmium concentrations, along with the average daily flow per month for the four outfalls. As shown in Table 3-61, 2013 cadmium loads for outfall 001 are below the facility's permit limits. However, 2013 cadmium discharges for outfalls SW3, SW4, and SW5 exceed the daily maximum benchmark concentration set in the facility permit.

Table 3-61. Nyrstar's 2013 DMR Monthly Cadmium Discharges

Outfall	Date	Flow (MGD)	Quantity (kg/day)	Concentration (mg/L)	NPDES Monthly Average Permit Limit[a]
001	31-Jan-13	0.610	0.503	NR	1.03 kg/day
001	28-Feb-13	0.660	0.370	NR	1.03 kg/day
001	31-Mar-13	0.605	0.610	NR	1.03 kg/day
001	30-Apr-13	0.680	0.660	NR	1.03 kg/day
001	31-May-13	0.720	0.707	NR	1.03 kg/day
001	30-Jun-13	0.590	0.340	NR	1.03 kg/day
001	31-Jul-13	0.630	0.260	NR	1.03 kg/day
001	31-Aug-13	0.830	0.770	NR	1.03 kg/day
001	30-Sep-13	0.690	0.270	NR	1.03 kg/day
001	31-Oct-13	0.710	0.410	NR	1.03 kg/day
001	30-Nov-13	0.590	0.370	NR	1.03 kg/day
001	31-Dec-13	0.750	0.707	NR	1.03 kg/day
SW3	31-Mar-13	0.130	NR	8.00[b]	0.0159 mg/L
SW3	30-Jun-13	0.260	NR	2.46[b]	0.0159 mg/L
SW3	30-Sept-13	0.710	NR	3.71[b]	0.0159 mg/L
SW3	31-Dec-13	0.120	NR	4.27[b]	0.0159 mg/L
SW4	31-Mar-13	0.099	NR	0.110[b]	0.0159 mg/L
SW4	30-Jun-13	0.140	NR	0.025[b]	0.0159 mg/L
SW4	30-Sept-13	0.380	NR	0.280[b]	0.0159 mg/L
SW4	31-Dec-13	0.098	NR	0.220[b]	0.0159 mg/L
SW5	31-Mar-13	0.850	NR	0.025[b]	0.0159 mg/L
SW5	30-Jun-13	1.30	NR	0.025[b]	0.0159 mg/L
SW5	30-Sept-13	3.31	NR	0.050[b]	0.0159 mg/L
SW5	31-Dec-13	0.850	NR	0.025[b]	0.0159 mg/L

Sources: *DMRLTOutput2013_v1*; TN DEC, 2011
NR: Not Reported
[a] EPA converted the facility's cadmium permit limits for outfall 001 to kg/day to match the units of the reported mass discharge loads; the permit lists the limit in lb/day. Additionally, the 0.0159 mg/L value, shown as the NPDES monthly average permit limit for outfalls SW3, SW4, and SW5, are benchmark concentrations, not effluent limitations.
[b] Cadmium concentration exceeds daily maximum benchmark concentration.

Table 3-62 presents Nyrstar's 2013 fluoride concentrations, along with the average daily flow per month for outfall 001. Because the facility reported fluoride quantities in kg/day for

[25] Benchmark/cutoff values are not effluent limitations. Outfalls SW3, SW4, and SW5 discharge stormwater runoff; therefore, benchmark/cutoff concentrations are listed in the facility's permit to evaluate the effectiveness of their stormwater best management practices (BMPs). If the facility discharge exceeds the benchmark concentration, the facility is required to complete investigations to determine the reason(s) the higher value(s) occurred and make BMP improvements, as needed, for the relevant parameter (TN DEC, 2011).

outfall 001, EPA calculated the fluoride concentrations using the pollutant load discharged and the average monthly flow. The facility has a once-per-month monitoring requirement for fluoride in their permit for outfall 001; the permit does not include fluoride effluent limits (TN DEC, 2011). As shown in Table 3-62, the fluoride concentrations vary by three orders of magnitude depending on the month for outfall 001. As part of the 2015 Annual Review, EPA contacted Nyrstar about the fluoride discharges. The facility contact confirmed the reported 2013 flow rates and concentrations and explained that a fluoride sample is taken once-per-month which may not be indicative of the entire month and would only be valid for the 24-hour period that the composite sample was collected. Other parameters reported for outfall 001 are averages of multiple samples throughout the month (Crocker, 2014).

Table 3-62. Nyrstar's 2013 DMR Monthly Fluoride Discharges for Outfall 001

Date	Reported Flow (MGD)	Reported Quantity (kg/day)	Calculated Concentration (mg/L)
31-Jan-13	0.610	24.9	10.8
28-Feb-13	0.660	29.1	11.6
31-Mar-13	0.605	43.7	19.1
30-Apr-13	0.680	66.8	26.0
31-May-13	0.720	698	256
30-Jun-13	0.590	5.19	2.32
31-Jul-13	0.630	97.1	40.7
31-Aug-13	0.830	62.2	19.8
30-Sep-13	0.690	431	165
31-Oct-13	0.710	2,720	1,010
30-Nov-13	0.590	13.1	5.87
31-Dec-13	0.750	5,940	2,090

Source: *DMRLTOutput2013_v1*

Table 3-63 presents Nyrstar's cadmium and fluoride DMR discharges for 2010 through 2014. EPA reviewed 2014 cadmium and fluoride discharges and confirmed that the discharges are not increasing; however, 2013 cadmium discharges exceed permit benchmark values for three of the four stormwater outfalls and 2013 fluoride concentrations vary by three orders of magnitude depending on the month.

Table 3-63. Nyrstar DMR Cadmium and Fluoride Discharges for 2010 – 2014

Year	Cadmium TWPE	Fluoride TWPE[a]
2010	99,700	NR
2011	112,000	NR
2012	166,000	783
2013	103,000	20,700
2014	103,000	6,700

Source: *DMRLTOutput2013_v1;* DMR Loading Tool.
Note: TWPE values are rounded to three significant figures.
NR: Not Reported
[a] Nyrstar was issued a new permit in 2012 that added the requirement for fluoride monitoring of outfall 001. Prior to 2012, the facility did not monitor fluoride discharges.

Horsehead Corporation (Fluoride Discharges)

Horsehead Corporation owned and operated a zinc smelter and ancillary units to produce zinc metal, zinc oxide, zinc dust, zinc sulfate, and sulfuric acid, in Monaca, PA. The facility was a zinc smelter that is subject to 40 CFR Part 421 Subpart H (Primary Zinc Subcategory). Subpart H does not regulate fluoride discharges. EPA previously reviewed the facility's fluoride discharges as part of the 2011 Annual Review; the facility contact confirmed the 2009 fluoride discharges and EPA recommended facility-specific permitting support to address the facility's fluoride discharges (U.S. EPA, 2012).

According to the facility's website, as of April 30, 2014, the operations in Monaca, PA were shut down. In May 2014, the facility started production of zinc metal at a new Mooresboro, NC location (Horsehead Corporation, 2014).[26] Table 3-64 presents Horsehead's Monaca, PA fluoride discharges for 2010 through 2014. As shown, discharges significantly decreased in 2014, when the facility closed at the end of April.

Table 3-64. Horsehead DMR Fluoride Discharges for 2010 – 2014

Year	Fluoride TWPE
2010	15,600
2011	11,600
2012	13,000
2013	15,200
2014	2,300

Source: *DMRLTOutput2013_v1;* DMR Loading Tool.

3.8.4 NFMM Category Findings

The estimated toxicity of the NFMM Category discharges resulted primarily from cadmium and fluoride discharges reported on DMRs. From the 2015 Annual Review, EPA found:

- One facility, Nyrstar Clarksville, Inc., in Clarksville, TN, accounted for over 99 percent of the 2013 DMR cadmium discharges and 50 percent of the 2013 DMR fluoride discharges. The facility's 2013 cadmium discharges are above permit benchmark values for three of the four stormwater outfalls. The facility's 2013 fluoride discharges vary by three orders of magnitude, depending on the month. The facility currently has reporting requirements for fluoride, but no specific limits.
- Horsehead Corporation in Monaca, PA, contributed 37 percent of the 2013 DMR fluoride discharges (note that Nyrstar Clarksville, Inc., discussed above, contributes 50 percent of the 2013 DMR fluoride discharges; the two facilities together account for 87 percent of the fluoride discharges). The facility closed in 2014.

3.8.5 NFMM Category References

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[26] No 2014 DMR data were submitted for the new facility in Mooresboro, NC.

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3. ERG. 2015. Preliminary Category Review – Facility Data Review for Point Source Category – 421 – NFMM. (September). EPA-HQ-OW-2015-0665. DCN 08169.
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5. TN DEC. 2005. Tennessee Department of Environment and Conservation. *NPDES Permit Fact Sheet: Nyrstar Clarksville, Inc., Clarksville, Tennessee*. (May 31). EPA-HQ-OW-2010-0824-0042.
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13. U.S. EPA. 2016. *Preliminary 2016 Effluent Guidelines Program Plan.* Washington, D.C. (June). EPA-821-R-16-001. EPA-HQ-OW-2015-0665. DCN 08208.

3.9 Ore Mining and Dressing (40 CFR Part 440)

EPA identified the Ore Mining and Dressing (Ore Mining) Category for preliminary review because it ranks high again, in terms of toxic-weighted pound equivalents (TWPE), in the final 2015 combined point source category rankings. Previously, EPA reviewed discharges from this category as part of the 2009, 2010, 2011, and 2013 Annual Reviews in which it also ranked high (U.S. EPA, 2009, 2011a, 2012, 2014). In addition, EPA conducted a preliminary study of this category as part of the 2009 and 2010 Annual Reviews (U.S. EPA, 2011b). From the preliminary study, EPA found that a small percentage of active mines account for the majority of toxic weighted discharges; therefore, discharge issues are best addressed through permitting, compliance, and enforcement activities rather than revision of 40 CFR Part 440 (U.S. EPA, 2011b).

This section summarizes the results of the 2015 Annual Review. EPA focused its 2015 review on discharges of copper, selenium, radium-226, arsenic, lead and lead compounds, and silver and silver compounds because of their high TWPE relative to other pollutants discharged by facilities in the Ore Mining Category. Copper and arsenic, reviewed as part of the 2013 Annual Review, continue to be top pollutants of concern. For the 2015 Annual Review, available discharge data also showed significant contributions of selenium, radium-226, lead and lead compounds, and silver and silver compounds.

3.9.1 Ore Mining Category 2015 Toxicity Rankings Analysis

Table 3-65 compares the toxicity rankings analyses (TRA) data for the Ore Mining Category from the 2011, 2013, and 2015 Annual Reviews. EPA did not conduct the TRA in 2012 or 2014, but instead reviewed additional data sources as part of the even-year annual review, as described in Section 2.2.1 of EPA's Preliminary 2016 Plan (U.S. EPA, 2016). During the 2015 Annual Review, EPA did not identify any data corrections to the 2013 Discharge Monitoring Report (DMR) and Toxic Release Inventory (TRI) discharge data for the Ore Mining Category.

Table 3-65. Ore Mining Category TRI and DMR Facility Counts and Discharges Reported in 2009, 2011, and 2013

Year of Discharge	Year of Review	Ore Mining Category Facility Counts[a]			Ore Mining Category TWPE		
		Total TRI Facilities	Total DMR Major Facilities	Total DMR Minor Facilities	TRI TWPE[b]	DMR TWPE[c]	Total TWPE
2009	2011	34	45	31	68,900	139,000	208,000
2011	2013	33	53	37	72,900[d]	110,000	183,000[d]
2013	2015	32	33	20	82,700	57,700	140,000

Sources: *TRIReleases2009_v2, DMRLoads2009_v2,* and 2011 Annual Review Report (for 2009 DMR and TRI data) (U.S. EPA, 2012); *DMRLTOutput2011_v1, TRILTOutput2011_v1,* and 2013 Annual Review Report (for 2011 DMR and TRI data) (U.S. EPA, 2014); *DMRLTOutput2013_v1* (for 2013 DMR); *TRILTOutput2013_v1* (for 2013 TRI).
Note: EPA did not evaluate 2010 or 2012 DMR and TRI data.
Note: TWPE values are rounded to three significant figures. Sums of individual values may not equal the total presented, due to rounding.

a Number of facilities with TWPE greater than zero.
b Discharges include direct discharges to surface waters and transfers to POTWs. Transfers to POTWs account for POTW removals.
c Includes DMR data from both major and minor dischargers.
d 2011 DMR data after corrections were made during the 2013 Annual Review.

As shown in Table 3-65, the number of TRI facilities with pollutant releases has decreased slightly, while the TRI TWPE has increased from 2009 to 2013. The number of DMR facilities with pollutant discharges increased from 2009 to 2011 then decreased substantially from 2011 to 2013, while the DMR TWPE decreased from 2009 to 2013. The total number of permitted facilities (not just those that reported discharges greater than zero) also decreased from 2011 to 2013 (DMR Pollutant Loading Tool), suggesting that the number of U.S. ore mines may be declining.

3.9.2 Ore Mining Category Pollutants of Concern

EPA's 2015 review of the Ore Mining Category focused on the 2013 DMR and TRI discharges because both contribute to the category's combined TWPE. Table 3-66 shows the five pollutants with the highest contribution to the 2013 DMR TWPE. As a point of comparison, Table 3-66 also shows the 2011 DMR facility count and TWPE for these top five pollutants, based on the 2013 Annual Review (U.S. EPA, 2014). Copper, selenium, radium-226, and arsenic contribute 67 percent of the total 2013 DMR TWPE. The Ore Mining effluent limitations guidelines and standards (ELGs) regulate copper, radium-226, and arsenic, but do not include limitations for selenium. Sections 3.9.3 through 3.9.6 present EPA's investigation of these top DMR pollutants. EPA did not investigate molybdenum as part of the 2015 Annual Review because it represents a small percentage (9 percent) of the 2013 DMR TWPE for the Ore Mining Category.

Table 3-67 shows the five pollutants with the highest contribution to the 2013 TRI TWPE. As a point of comparison, Table 3-67 also shows the 2011 TRI facility count and TWPE for these top five pollutants, based on the 2013 Annual Review (U.S. EPA, 2014). EPA investigated lead and lead compounds and silver and silver compounds because they contribute over 71 percent of the total 2013 TRI TWPE. Additionally, EPA investigated TRI discharges of arsenic and arsenic compounds and copper and copper compounds because they are top DMR pollutants. Sections 3.9.3 and 3.9.6 through 3.9.8 present EPA's investigation of reported releases of the top TRI pollutants. EPA did not investigate vanadium and vanadium compounds as part of the 2015 Annual Review because they represent a small percentage (less than 8 percent) of the 2013 TRI TWPE for the Ore Mining Category.

Table 3-66. Ore Mining Category Top DMR Pollutants

Pollutant[b]	2013 DMR Data[a]		2011 DMR Data[a]	
	Number of Facilities Reporting Pollutant[c]	TWPE	Number of Facilities Reporting Pollutant[c]	TWPE
Copper	30	14,100	49	6,940
Selenium	13	9,140	15	2,060
Radium-226	4	8,050	0	0
Arsenic	14	7,470	19	11,800
Molybdenum	4	5,250	4	5,700
Top Pollutant Total	**NA**	**44,000**	**NA**	**26,500**
Ore Mining Category Total	**53**	**57,700**	**90**	**110,000**

Sources: *DMRLTOutput2013_v1* (for 2013 TWPE); *DMRLTOutput2011_v1* (for 2011 facility counts)

Note: Sums of individual values may not equal the total presented, due to rounding.

NA: Not applicable.

a Includes DMR data from both major and minor dischargers.

b Molybdenum discharges contribute 9 percent of the 2013 category DMR TWPE. Therefore, EPA did not review molybdenum discharges as part of the 2015 Annual Review.

c Number of facilities with TWPE greater than zero.

Table 3-67. Ore Mining Category Top TRI Pollutants

Pollutant[a]	2013 TRI Data		2011 TRI Data	
	Number of Facilities Reporting Pollutant[b]	TWPE	Number of Facilities Reporting Pollutant[b]	TWPE[c]
Lead and Lead Compounds	25	42,700	25	33,600
Silver and Silver Compounds	3	16,500	3	16,500
Vanadium and Vanadium Compounds	4	5,920	4	4,530
Arsenic and Arsenic Compounds	5	4,640	6	3,820
Copper and Copper Compounds	17	3,110	17	3,280
Top Pollutant Total	**NA**	**72,900**	**NA**	**61,700**
Ore Mining Category Total	**32**	**82,700**	**33**	**72,900**

Sources: *TRILTOutput2011_v1* (for 2011 TRI TWPE); *TRILTOutput2013_v1* (for 2013 TRI TWPE)
Note: Sums of individual values may not equal the total presented, due to rounding.
NA: Not applicable.
[a] Vanadium and vanadium compound releases contribute less than 8 percent of the 2013 category TRI TWPE. Therefore, EPA did not review vanadium and vanadium compound releases as part of the 2015 Annual Review.
[b] Number of facilities with TWPE greater than zero.
[c] 2011 data after corrections were made during the 2013 Annual Review.

3.9.3 Ore Mining Copper Discharges in DMR and TRI

EPA's investigation of the copper and copper compound discharges in TRI revealed that 17 facilities account for 3,110 TWPE, with no facility contributing more than 200 TWPE, on average. Because each facility contributes less than 200 TWPE on average, EPA did not review copper and copper compound releases reported to TRI for individual facilities.

In contrast to TRI, EPA's investigation of the DMR copper discharges revealed that two facilities, Northshore Mining – Silver Bay, in Silver Bay, MN, and Copper Range Company's White Pine Mine, in White Pine, MI, account for 76 percent of the 2013 DMR copper discharges (shown in Table 3-68). EPA did not investigate the remaining facilities discharging copper as part of the 2015 Annual Review.

Table 3-68. Top 2013 DMR Copper Discharging Facilities

Facility Name	Facility Location	Pounds of Pollutant Discharged	Pollutant TWPE	Percent of Category TWPE
Northshore Mining – Silver Bay	Silver Bay, MN	11,500	7,260	51.7%
Copper Range Company White Pine Mine	White Pine, MI	5,420	3,420	24.3%
All other copper dischargers in the Ore Mining Category[a]		5,360	3,380	24.0%
Total		**22,300**	**14,100**	**100%**

Source: *DMRLTOutput2013_v1*.
Note: Sums of individual values may not equal the total presented, due to rounding.
[a] 28 additional facilities submitted copper discharges in the 2013 DMR data.

Northshore Mining – Silver Bay

Northshore Mining in Silver Bay, MN, is a taconite[27] mine with a processing facility and power plant onsite. The facility discharges copper from one outfall. As part of the 2015 Annual Review, EPA contacted the mine about the copper discharges. The facility contact confirmed the 2013 DMR copper discharges and stated that the facility monitors copper discharges yearly from a non-contact cooling water discharge from the onsite power plant, in accordance with the facility's NPDES permit. The facility does not have a permit limit for copper (Hayden, 2015). The Iron Ore Subcategory, Subpart A, of the Ore Mining ELGs does not include limitations for copper.

Table 3-69 presents Northshore Mining's copper discharges from 2010 through 2014. As shown, discharges increased from 2012 to 2013, but decreased from 2013 to 2014. The facility has historically collected samples from a sample port on the discharge pipe. In June and July 2015, the facility collected samples from the sample port on the discharge pipe, inside the diffuser box at the outlet to the lake, and from the lake. It was determined that sample contamination is occurring from the sample port on the discharge pipe, resulting in elevated copper discharges. The facility contact stated that starting with the 2015 reporting year; the facility will collect samples from inside the diffuser box at the outlet to the lake and submit the results on their DMRs (Hayden, 2015). Therefore, EPA expects copper discharges from this facility to decrease in future years.

Table 3-69. Northshore Mining's DMR Copper Discharges from 2010 – 2014

Year	Pounds	TWPE
2010	8,250	5,200
2011	4,740	2,980
2012	6,110	3,850
2013	11,500	7,260
2014	4,170	2,630

Source: *DMRLTOutput2013_v1;* DMR Loading Tool.

[27] Taconite is a low-grade iron ore.

Copper Range Company's White Pine Mine

Copper Range Company's White Pine Mine, in White Pine, MI, was an active copper mine from 1952 to 1995 (Michelson, 2014). As part of the 2015 Annual Review, EPA contacted the Michigan Department of Environmental Quality (MI DEQ) regarding the mine's copper discharges. The MI DEQ contact stated that the White Pine Mine is closed and the discharges are from tailings runoff. The mine has an active NPDES permit, with monitoring-only requirements for copper (MI DEQ, 2010). The MI DEQ contact also stated that stormwater runoff typically drives the copper discharges for the mine, resulting in higher copper discharges with higher precipitation (Conroy, 2015). The Copper, Lead, Zinc, Gold, Silver, and Molybdenum Ores Subcategory, Subpart J, of the Ore Mining ELGs includes concentration limitations for copper of 0.15 mg/L monthly average and 0.30 mg/L daily maximum. EPA compared the 2013 copper concentrations from the White Pine Mine to the Subpart J copper ELGs and found that all concentrations are below the monthly average and daily maximum limitations.

3.9.4 Ore Mining Selenium Discharges in DMR

EPA's investigation of the selenium discharges revealed that one facility, Tilden Mine in Ishpeming, MI, accounts for 89 percent of the 2013 selenium discharges (shown in Table 3-70). The remaining facilities account for a combined TWPE of 965, therefore, EPA did not investigate the remaining facilities discharging selenium as part of the 2015 Annual Review.

Table 3-70. Top 2013 DMR Selenium Discharging Facilities

Facility Name	Facility Location	Pounds of Pollutant Discharged	Pollutant TWPE	Percent of Category TWPE
Tilden Mine[a]	Ishpeming, MI	7,300	8,170	89.4%
All other selenium dischargers in the Ore Mining Category[b]		862	965	10.6%
Total		**8,160**	**9,140**	**100%**

Source: *DMRLTOutput2013_v1*.
Note: Sums of individual values may not equal the total presented, due to rounding.
a This facility is named Cliffs District Lab in the DMR database (*DMRLTOutput2013_v1*). However, the facility's permit lists the permittee as Tilden Mine.
b 12 additional facilities submitted selenium discharges in the 2013 DMR data.

Tilden Mine is a hematite[28] mine. The Iron Ore Subcategory, Subpart A, of the Ore Mining ELGs does not include limitations for selenium. As part of the 2015 Annual Review, EPA contacted the company to discuss their selenium discharges. Tilden Mine has a large tailings pond and sends the water through clarifiers before it is discharged. The facility permit was reissued in 2012 and included a schedule of compliance for selenium discharges. The facility completed a feasibility study of treatment options in August 2013, and is currently performing pilot studies for selected selenium treatment systems. The facility plans to implement a treatment system and meet permit limits[29] for selenium by November 2017 (Ketzenberger,

[28] Hematite is the mineral form of iron (III) oxide.
[29] The 2012 facility permit lists total selenium permit limits of 1.1 lb/day and 5.1 µg/L monthly average for outfall 002, effective November 1, 2017.

2015). EPA expects decreases in selenium discharges from this facility on future DMRs because of new limits on their permit and because new on site treatment technologies are to be installed at this facility.

3.9.5 Ore Mining Radium-226 Discharges in DMR

EPA's investigation of the radium-226 discharges revealed that one facility, JD-7 and JD-9 Mines in Naturita, CO, accounts for over 99 percent of the 2013 radium-226 discharges (shown in Table 3-71). EPA did not investigate the remaining facilities discharging radium-226 as part of the 2015 Annual Review.

Table 3-71. Top 2013 DMR Radium-226 Discharging Facilities

Facility Name	Facility Location	Pounds of Pollutant Discharged	Pollutant TWPE	Percent of Category TWPE
JD-7 and JD-9 Mines	Naturita, CO	0.00194	8,040	99.9%
All other radium-226 dischargers in the Ore Mining Category[a]		0.00000120	4.94	0.06%
Total		**0.00195**	**8,050**	**100%**

Source: *DMRLTOutput2013_v1.*
Note: Sums of individual values may not equal the total presented, due to rounding.
a Three additional facilities submitted radium-226 discharges in the 2013 DMR data.

JD-7 and JD-9 mines, owned by the Cotter Corporation, are uranium and vanadium mines. The Uranium, Radium, and Vanadium Ores Subcategory, Subpart C, of the Ore Mining ELGs includes concentration limitations for total Radium-226 10 mg/L monthly average and 30 mg/L daily maximum. The mines have not been actively operating since 1980. However, Cotter Corporation keeps the mines on active standby status, ready to resume production (CDPHE, 2011).

The 2013 radium-226 DMR discharge resulted from one measured concentration from outfall 001B at the JD-7 mine in September 2013. The facility discharges process water from the mine's waste dump through outfall 001B. As part of the 2015 Annual Review, EPA contacted the Colorado Department of Public Health and Environment (CDPHE) to discuss the mine's radium-226 discharges. The CDPHE contact confirmed the radium-226 discharge and contacted the facility directly to determine the reason behind the September 2013 discharge. The facility contact stated that a major flooding event in September 2013 caused the radium-226 discharge (Morgan, 2015). The facility has had no other radium-226 discharges from 2011 through 2014, indicating that the September 2013 discharge was an outlier.

3.9.6 Ore Mining Arsenic Discharges in DMR and TRI

EPA's investigation of the arsenic discharges in DMR and TRI revealed that one facility, Kennecott Utah Copper Smelter and Refinery (Kennecott Utah) in Magna, UT, accounts for 69 percent and 66 percent of the DMR and TRI arsenic discharges, respectively (shown in Table 3-72 and Table 3-73). The remaining facilities account for a combined TWPE of 1,290 in DMR and 1,560 in TRI, therefore, EPA did not investigate the remaining facilities discharging arsenic in DMR or TRI as part of the 2015 Annual Review.

Table 3-72. Top 2013 DMR Arsenic Discharging Facilities

Facility Name	Facility Location	Pounds of Pollutant Discharged	Pollutant TWPE	Percent of Category TWPE
Kennecott Utah Copper Smelter & Refinery	Magna, UT	1,290	5,200	69.6%
All other arsenic dischargers in the Ore Mining Category[a]		561	2,270	30.4%
Total		**1,850**	**7,470**	**100%**

Source: *DMRLTOutput2013_v1.*
Note: Sums of individual values may not equal the total presented, due to rounding.
[a] 13 additional facilities submitted arsenic discharges in the 2013 DMR data.

Table 3-73. Top Facilities Reporting 2013 TRI Arsenic and Arsenic Compound Releases

Facility Name	Facility Location	Pounds of Pollutant Released	Pollutant TWPE	Percent of Category TWPE
Kennecott Utah Copper Smelter & Refinery	Magna, UT	762	3,080	66.4%
All other arsenic dischargers in the Ore Mining Category[a]		386	1,560	33.6%
Total		**1,150**	**4,640**	**100%**

Source: *TRILTOutput2013_v1.*
Note: Sums of individual values may not equal the total presented, due to rounding.
[a] Four additional facilities reported arsenic and arsenic compound releases in the 2013 TRI.

Kennecott Utah, owned by Rio Tinto, is a large, integrated facility that includes an open pit copper mine, a concentrator, a power plant, a smelter, a refinery, a reverse osmosis plant, a tailings pond, and a sewage treatment plant. All active facilities are west of Salt Lake City, UT. The concentrator typically processes approximately 170,000 tons of ore per day from the Bingham Canyon Mine (UT DEQ, 2009).

The facility discharges arsenic from six outfalls. Table 3-74 presents Kennecott Utah's DMR and TRI arsenic discharges from 2007 through 2014. As shown, both DMR and TRI arsenic discharges have remained consistent over this time period. Table 3-75 presents Kennecott Utah's 2013 DMR arsenic discharges and NPDES permit limits.[30] As shown, all 2013 DMR arsenic discharges are below the NPDES monthly average and daily maximum permit limits. The facility's high arsenic TWPE likely results from the relatively high level of industrial activity at the site.

Table 3-74. Kennecott Utah's DMR and TRI Arsenic Discharges from 2007 – 2014

Year	DMR TWPE	TRI TWPE
2007	3,170	1,170

[30] The facility's permit limits are based on the Ore Mining ELGs (40 CFR Part 440), Nonferrous Metals Manufacturing ELGs (40 CFR Part 421), Utah Secondary Treatment Standards, and Utah Water Quality Standards (UT DEQ, 2009).

Table 3-74. Kennecott Utah's DMR and TRI Arsenic Discharges from 2007 – 2014

Year	DMR TWPE	TRI TWPE
2008	5,460	1,210
2009	5,730	2,890
2010	5,370	1,230
2011	5,470	2,260
2012	4,230	1,210
2013	5,200	3,080
2014	3,790	NA

Source: *DMRLTOutput2013_v1; TRILTOutput2013_v1;* DMR Loading Tool.
NA: Not available.

Table 3-75. Kennecott Utah's 2013 DMR Arsenic Discharges

Outfall	Date	Reported Monthly Average Data			NPDES Permit Limits	
		Flow (MGD)	Quantity (kg/day)	Concentration (mg/L)	Monthly Average	Daily Maximum
004	31-Mar-13	7.6	NR	0.015	Monitoring Only	Monitoring Only
004	30-Jun-13	0	NR	0	Monitoring Only	Monitoring Only
004	30-Sep-13	4.6	NR	0.053	Monitoring Only	Monitoring Only
004	31-Dec-13	5.12	NR	0.03	Monitoring Only	Monitoring Only
008	31-Mar-13	0	NR	0	0.25 mg/L	0.50 mg/L
008	30-Jun-13	0.08	NR	0.068	0.25 mg/L	0.50 mg/L
008	30-Sep-13	0	NR	0	0.25 mg/L	0.50 mg/L
008	31-Dec-13	0	NR	0	0.25 mg/L	0.50 mg/L
010	31-Mar-13	0.05	NR	0.008	Monitoring Only	0.10 mg/L
010	30-Jun-13	0.04	NR	0.011	Monitoring Only	0.10 mg/L
010	30-Sep-13	0.05	NR	0.007	Monitoring Only	0.10 mg/L
010	31-Dec-13	0.07	NR	0.008	Monitoring Only	0.10 mg/L
012	31-Jan-13	13.2	NR	<0.005	0.25 mg/L	0.50 mg/L
012	28-Feb-13	15	NR	0.012	0.25 mg/L	0.50 mg/L
012	31-Mar-13	21.5	NR	0.018	0.25 mg/L	0.50 mg/L
012	30-Apr-13	19.5	NR	0.076	0.25 mg/L	0.50 mg/L
012	31-May-13	13.6	NR	0.043	0.25 mg/L	0.50 mg/L
012	30-Jun-13	0	NR	0	0.25 mg/L	0.50 mg/L
012	31-Jul-13	0	NR	0	0.25 mg/L	0.50 mg/L
012	31-Aug-13	0	NR	0	0.25 mg/L	0.50 mg/L
012	30-Sep-13	0	NR	0	0.25 mg/L	0.50 mg/L
012	31-Oct-13	20.1	NR	0.014	0.25 mg/L	0.50 mg/L
012	30-Nov-13	14	NR	0.032	0.25 mg/L	0.50 mg/L
012	31-Dec-13	0	NR	0	0.25 mg/L	0.50 mg/L
104	31-Jan-13	0.28	<0.0027	NR	5.08 kg/day	12.4 kg/day
104	28-Feb-13	0.34	0.0077	NR	5.08 kg/day	12.4 kg/day

104	31-Mar-13	0.31	0.0108	NR	5.08 kg/day	12.4 kg/day
104	30-Apr-13	0.29	0.34	NR	5.08 kg/day	12.4 kg/day
104	31-May-13	0.32	0.052	NR	5.08 kg/day	12.4 kg/day
104	30-Jun-13	0	0	NR	5.08 kg/day	12.4 kg/day
104	31-Jul-13	0	0	NR	5.08 kg/day	12.4 kg/day
104	31-Aug-13	0	0	NR	5.08 kg/day	12.4 kg/day
104	30-Sep-13	0.3	0.013	NR	5.08 kg/day	12.4 kg/day
104	31-Oct-13	0.34	0.016	NR	5.08 kg/day	12.4 kg/day
104	30-Nov-13	0.29	0.027	NR	5.08 kg/day	12.4 kg/day
104	31-Dec-13	0.25	0.011	NR	5.08 kg/day	12.4 kg/day
SW4	30-Jun-13	0.0000099	NR	0.053	Monitoring Only	Monitoring Only
SW4	31-Dec-13	0.000099	NR	0.006	Monitoring Only	Monitoring Only

Source: *DMRLTOutput2013_v1*; UT DEQ, 2009

3.9.7 Ore Mining Lead and Lead Compound Discharges in TRI

EPA's investigation of lead and lead compound discharges revealed that three facilities account for 91 percent of the lead and lead compound discharges reported in to TRI in 2013 (shown in Table 3-76). The remaining facilities account for a combined TWPE of 3,500, therefore, EPA did not investigate the remaining facilities discharging lead and lead compounds as part of the 2015 Annual Review.

Table 3-76. Top Facilities Reporting 2013 TRI Lead and Lead Compound Releases

Facility Name	Facility Location	Pounds of Pollutant Released	Pollutant TWPE	Percent of Category TWPE
Fletcher Mine	Centerville, MO	8,250	18,500	43.3%
Buick Mine	Boss, MO	6,870	15,400	36.0%
Brushy Creek Mine	Boss, MO	2,390	5,360	12.5%
All other lead and lead compound dischargers in the Ore Mining Category[a]		1,560	3,500	8.20%
Total		**19,100**	**42,700**	**100%**

Source: *TRILTOutput2013_v1*
Note: Sums of individual values may not equal the total presented, due to rounding.
[a] 22 additional facilities reported lead and lead compound releases in the 2013 TRI.

Fletcher Mine, in Centerville, MO, and Buick Mine and Brushy Creek Mine in Boss, MO, are owned by Doe Run Resources Corporation, a lead mining company headquartered in St. Louis, MO, with facilities in southeast Missouri. Doe Run owns and operates several mining and milling facilities, as well as primary and secondary lead smelters. Ore from the mines at the Doe Run facilities is crushed, milled, and processed; lead concentrate is transported from the mills to the primary and secondary lead smelters for smelting and refining. Doe Run Resources Corporation agreed to a consent decree on October 8, 2010 with the U.S. Department of Justice, EPA, and the Missouri Department of Natural Resources (MO DNR), to spend approximately $65 million to correct violations of several environmental laws at 10 of its lead mining, milling, and smelting facilities in southeast Missouri. These 10 facilities include Fletcher Mine, Buick Mine, and Brushy Creek Mine (U.S. EPA, 2010).

As part of the 2015 Annual Review, EPA contacted MO DNR about lead and lead compound releases from these mines. The MO DNR contact stated that the mines are active and there is an administrative stay on enforcement activities for the sites due to the consent decree (Sappington, 2014). Table 3-77 presents the lead and lead compound TRI releases for Fletcher Mine, Buick Mine, and Brushy Creek Mine. As shown, lead and lead compound TRI releases have increased for all mines from 2009 to 2013. However, due to the consent decree, EPA expects lead discharges to decrease from Doe Run facilities over the next several years.

Table 3-77. TRI Lead and Lead Compound Releases from 2009 – 2013

Year	Fletcher Mine TWPE	Buick Mine TWPE	Brushy Creek Mine TWPE
2009	9,230	11,300	4,120
2010	7,700	10,200	2,710
2011	11,700	11,900	5,970
2012	10,500	12,800	3,480
2013	18,500	15,400	5,360

Source: *TRILTOutput2013_v1;* DMR Loading Tool.

3.9.8 Ore Mining Silver and Silver Compound Discharges in TRI

EPA's investigation of the silver and silver compound discharges revealed that two facilities, Kennecott Utah Copper Smelter & Refinery, in Magna, UT and Kennecott Utah Copper Mine, in Bingham Canyon, UT, account for over 99 percent of the 2013 silver and silver compound discharges (shown in Table 3-78). EPA did not investigate the remaining facility discharging silver and silver compounds as part of the 2015 Annual Review.

Table 3-78. Top Facilities Reporting 2013 TRI Silver and Silver Compound Releases

Facility Name	Facility Location	Pounds of Pollutant Released	Pollutant TWPE	Percent of Category TWPE
Kennecott Utah Copper Smelter & Refinery	Magna, UT	500	8,240	49.9%
Kennecott Utah Copper Mine	Bingham Canyon, UT	500	8,240	49.9%
Freeport-McMoran Miami Inc.	Claypool, AZ	0.6	9.88	0.06%
Total		**1,000**	**16,500**	**100%**

Source: *TRILTOutput2013_v1*
Note: Sums of individual values may not equal the total presented, due to rounding.

Rio Tinto owns both the Kennecott Utah Copper Smelter and Refinery, in Magna, UT, and Kennecott Utah Copper Mine, in Bingham Canyon, UT. Section 3.9.6 discusses arsenic discharges from the Magna, UT location, which is a large, integrated copper mining facility. Both facilities reported 500 pounds of silver and silver compounds discharged to TRI from 2007 through 2013.

As part of the 2015 Annual Review, EPA contacted Rio Tinto to confirm the TRI silver and silver compound releases for both Kennecott facilities. According to the contact, the company bases the TRI silver and silver compound release on plant knowledge that silver releases are at least an order of magnitude less than copper releases, and on historical plant data for silver concentrations in the tailings pond. The facility uses a conservative maximum estimate of 1,000 pounds of silver released to water, divided equally between the copper smelter and refinery in Magna, UT, and the mine in Bingham Canyon, UT (Nannini, 2014). The facility does not have silver discharges in the 2013 DMR data.

3.9.9 Ore Mining Category Findings

The estimated toxicity of the Ore Mining Category discharges resulted primarily from copper, selenium, radium-226, and arsenic discharges reported on DMRs, and lead and lead compound and silver and silver compound releases reported to TRI. From the 2015 Annual Review, EPA found:

- ***Copper.*** Two facilities, Northshore Mining, in Silver Bay, MN, and White Pine Mine, in White Pine, MI, account for 76 percent of the 2013 copper discharges. The Northshore Mining facility contact confirmed that copper discharges result from contamination at the sample port on the discharge pipe. Starting with the 2015 reporting year, the facility will collect samples from inside the diffuser box at the outlet to the lake. Therefore, EPA expects copper discharges from this facility to decrease in future years. The White Pine Mine is closed and discharges are from tailings runoff, which typically fluctuate with yearly rainfall. EPA does not consider these copper discharges to be representative of the Ore Mining Category.
- ***Selenium.*** One facility, Tilden Mine in Ishpeming, MI, accounts for 89 percent of the 2013 selenium discharges. The facility permit was reissued in 2012 and included a schedule of compliance for selenium discharges. The facility plans to implement new on site treatment technologies to meet revised permit limits for selenium by 2017; therefore, EPA expects decreases in selenium discharges from this facility on future DMRs.
- ***Radium-226.*** One facility, JD-7 and JD-9 mines in Naturita, CO, accounts for over 99 percent of the 2013 radium-226 discharges. The 2013 radium-226 discharges resulted from one measured concentration from an outfall where the facility discharges process water from the mine's waste dump. The facility confirmed the 2013 discharge resulted from a major flooding event at the site in September 2013; the facility has had no other radium-226 discharges from 2011 through 2014, indicating that the 2013 discharge was an outlier. For this reason, EPA does not consider radium-226 discharges from the JD-7 and JD-9 mines to be representative of typical discharges from this facility or from the Ore Mining Category.
- ***Arsenic.*** One facility, Kennecott Utah Copper Smelter and Refinery in Magna, UT, accounts for 69 percent and 66 percent of the DMR and TRI arsenic discharges, respectively. The facility is a large, integrated copper mining facility. The facility's 2013 DMR arsenic discharges are below the NPDES monthly average and daily maximum permit limits. The facility's high arsenic TWPE likely results from the

relatively high level of industrial activity at the site. Therefore, EPA does not consider the facility's arsenic discharges to be representative of discharges across the Ore Mining Category.

- ***Lead.*** Three mines, Fletcher Mine, in Centerville, MO, and Buick Mine and Brushy Creek Mine, in Boss, MO, account for 91 percent of the TRI lead and lead compound releases; Doe Run Resources Corporation owns all three mines. Doe Run agreed to a consent decree on October 8, 2010 to correct violations of several environmental laws at many of its facilities, including Fletcher Mine, Buick Mine, and Brushy Creek Mine. Therefore, EPA expects lead discharges from Doe Run facilities to decrease in the future.
- ***Silver.*** Two facilities, Kennecott Utah Copper Smelter and Refinery, Magna, UT, and Kennecott Utah Copper Mine in Bingham Canyon, UT, account for over 99 percent of the 2013 silver and silver compound releases. Rio Tinto owns both facilities, which are part of a large, integrated copper mining facility. The facility confirmed the 2013 TRI silver and silver compound releases and stated that the releases are based on estimates from historical plant data for silver concentrations. Because the facility bases its reported TRI releases on conservative estimates not confirmed with sampling data, EPA cannot asses how representative they are of actual silver and silver compound releases from the facility.

3.9.10 Ore Mining and Dressing Category References

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11. U.S. EPA. 2009. *Technical Support Document for the Preliminary 2010 Effluent Guidelines Program Plan*. Washington, D.C. (October). EPA-821-R-09-006. EPA-HQ-OW-2008-0517-0514.

12. U.S. EPA. 2010. *Doe Run Resources Corporation Settlement.* (October 8). EPA-HQ-OW-2015-0665. DCN 08196.

13. U.S. EPA. 2011a. *Technical Support Document for the 2010 Effluent Guidelines Program Plan*. Washington, D.C. (October). EPA 820-R-10-021. EPA-HQ-OW-2008-0517-0618.

14. U.S. EPA. 2011b. *Ore Mining and Dressing Preliminary Study Report*. Washington, D.C. (December). EPA-821-R-08-012. EPA-HQ-OW-2008-0517-0712.

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17. U.S. EPA. 2016. *Preliminary 2016 Effluent Guidelines Program Plan.* Washington, D.C. (June). EPA-821-R-16-001. EPA-HQ-OW-2015-0665. DCN 08208.

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3.10 Organic Chemicals, Plastics, and Synthetic Fibers (40 CFR Part 414)

EPA identified the Organic Chemicals, Plastics, and Synthetic Fibers (OCPSF) Category for preliminary review because it ranks high again, in terms of toxic-weighted pound equivalents (TWPE), in the final 2015 combined point source category rankings. Previously, EPA reviewed discharges from this category as part of the 2004 through 2011, and 2013 Annual Reviews in which it also ranked high (U.S. EPA, 2004, 2005a, 2005b, 2006, 2007, 2008, 2009, 2011a, 2012, 2014). In addition, EPA conducted a preliminary study of carbon disulfide discharges from cellulose products manufacturers in 2011 (U.S. EPA, 2011b) and reviewed discharges from the chlorinated hydrocarbon manufacturing segment of the OCPSF Category as part of the Chlorine and Chlorinated Hydrocarbons (CCH) effluent guidelines rulemaking.[31]

This section summarizes the results of the 2015 Annual Review. EPA focused its 2015 review on discharges of polycyclic aromatic compounds (PACs), total residual chorine, hexachlorobenzene, dioxin and dioxin-like compounds, carbon disulfide, and nitrate compounds because of their high TWPE relative to the other pollutants discharged by facilities in the OCPSF Category. Total residual chlorine and hexachlorobenzene, reviewed as part of the 2013 Annual Review, continue to contribute large proportions of the total category TWPE. For the 2015 Annual Review, available discharge data also showed significant contributions of PACs, dioxin and dioxin-like compounds, carbon disulfide, and nitrate compounds.

3.10.1 OCPSF Category 2015 Toxicity Rankings Analysis

Table 3-79 compares the toxicity rankings analyses (TRA) data for the OCPSF Category from the 2011, 2013, and 2015 Annual Reviews. EPA did not conduct the TRA in 2012 or 2014, but instead reviewed additional data sources as part of the even-year annual review, as described in Section 2.2.1 of EPA's Preliminary 2016 Plan (U.S. EPA, 2016). As discussed in this section, during the 2015 Annual Review, EPA identified data corrections that affected the 2013 Discharge Monitoring Report (DMR) and Toxic Release Inventory (TRI) data and TWPE. The bottom row of Table 3-79 shows the corrected data resulting from this review.

[31] Based on the information collected during the rulemaking, EPA proposed to delist the CCH manufacturing industry and discontinue the rulemaking in 2012.

Table 3-79. OCPSF Category TRI and DMR Facility Counts and Discharges Reported in 2009, 2011, and 2013

		OCPSF Category Facility Counts[a]			OCPSF Category TWPE		
Year of Discharge	Year of Review	Total TRI Facilities	Total DMR Major Facilities	Total DMR Minor Facilities	TRI TWPE[b]	DMR TWPE[c]	Total TWPE
2009	2011	671	169	150	146,000	491,000[d]	637,000[d]
2011	2013	631	165	180	148,000	658,000[e]	806,000[e]
2013	2015	651	136	144	333,000[f]	301,000[f]	634,000[f]
					286,000[g]	224,000[g]	510,000[g]

Sources: 2013 Annual Review Report (for 2009 and 2011 DMR and TRI data) (U.S. EPA, 2014); *DMRLTOutput2013_v1* (for 2013 DMR); *TRILTOutput2013_v1* (for 2013 TRI).
Note: EPA did not evaluate 2010 or 2012 DMR and TRI data.
Note: TWPE values are rounded to three significant figures. Sums of individual values may not equal the total presented, due to rounding.
a Number of facilities with TWPE greater than zero.
b Releases include direct discharges to surface waters and transfers to POTWs. Transfers to POTWs account for POTW removals.
c Includes DMR data from both major and minor dischargers.
d 2009 DMR data after corrections were made during the 2011 Annual Review.
e 2011 DMR data after corrections were made during the 2013 Annual Review.
f 2013 DMR data prior to corrections made during the 2015 Annual Review.
g 2013 DMR data after corrections were made during the 2015 Annual Review.

As shown in Table 3-79, the total TWPE increased from 2009 to 2011 then decreased from 2011 to 2013, mainly due to a decrease in DMR discharges. However, TRI releases increased, driven by a substantial rise in reported releases of carbon disulfide (discussed in Section 3.10.7, below). Additionally, the number of facilities reporting discharges on DMRs decreased from 2009 to 2013.

3.10.2 OCPSF Category Pollutants of Concern

EPA's 2015 review of the OCPSF Category focused on the 2013 DMR and TRI discharges because both contribute to the category's combined TWPE. Table 3-80 shows the five pollutants with the highest contribution to the 2013 DMR TWPE. As a point of comparison, Table 3-80 also shows the 2011 DMR facility count and TWPE for these top pollutants, based on the 2013 Annual Review (U.S. EPA, 2014). The top five pollutants contribute more than 60 percent of the original 2013 DMR TWPE for the OCPSF Category (prior to corrections discussed below). The OCPSF effluent limitations guidelines and standards (ELGs) currently regulate benzo[a]pyrene, hexachlorobenzene, and benzo[k]fluoranthene, but not total residual chlorine or 2,3,7,8-tetrachlorodibenzo-p-dioxin. EPA's investigations of reported discharges of these pollutants are summarized in Sections 3.10.3 to 3.10.6.

Table 3-81 shows the five pollutants with the highest contribution to the 2013 TRI TWPE. As a point of comparison, Table 3-81 also shows the 2011 TRI facility count and TWPE for these top pollutants, based on the 2013 Annual Review (U.S. EPA, 2014). Carbon disulfide, dioxin and dioxin-like compounds, PACs, and nitrate compounds contribute 77 percent of the original 2013 TRI TWPE for the OCPSF Category (prior to corrections discussed below). EPA's investigations of reported discharges of these pollutants are summarized in Sections 3.10.3, and 3.10.6 through 3.10.8. EPA did not investigate hydroquinone as part of the 2015 Annual Review because it represents a small percentage (less than 4 percent) of the 2013 TRI TWPE for the OCPSF Category.

Table 3-80. OCPSF Category Top DMR Pollutants

Pollutant	2013 DMR Data[a]			2011 DMR Data[a]	
	Number of Facilities Reporting Pollutant[c]	Original TWPE	Corrected TWPE	Number of Facilities Reporting Pollutant[b]	TWPE
Benzo[a]pyrene	12	59,800	3,230	11	37,200
Total Residual Chlorine	97	49,200	49,200	110	59,500
Hexachlorobenzene	10	28,800	28,800	11	61,800
2,3,7,8-Tetrachlorodibenzo-p-dioxin	2	25,200	25,200	1	1,000
Benzo[k]fluoranthene	9	18,200	971	10	10,200
Top Pollutant Total	**NA**	**181,000**	**107,000**	**NA**	**179,000**
OCPSF Category Total	**280**	**301,000**	**224,000**	**345**	**658,000**

Sources: *DMRLTOutput2013_v1* (for 2013 data); *DMRLTOutput2011_v1* (for 2011 data).
Note: Sums of individual values may not equal the total presented due to rounding.
NA: Not applicable.
[a] Includes DMR data from both major and minor dischargers.
[b] Number of facilities with TWPE greater than zero.

Table 3-81. OCPSF Category Top TRI Pollutants

Pollutant[a]	2013 TRI Data			2011 TRI Data	
	Number of Facilities Reporting Pollutant[b]	Original TWPE	Corrected TWPE	Number of Facilities Reporting Pollutant[b]	TWPE
Carbon Disulfide	10	157,000	157,000	8	5,310
Dioxin and Dioxin-like Compounds	3	69,700	22,500	4	25,000
Polycyclic Aromatic Compounds	9	16,300	16,300	8	7,530
Nitrate Compounds	121	13,200	13,200	104	14,200
Hydroquinone	5	10,300	10,300	5	8,790
Top Pollutant Total	**NA**	**267,000**	**220,000**	**NA**	**60,800**
OCPSF Category Total	**651**	**333,000**	**286,000**	**631**	148,000

Sources: *TRILTOutput2011_v1; TRILTOutput2013_v1.*
Note: Sums of individual values may not equal the total presented, due to rounding.
NA: Not applicable.
[a] Hydroquinone releases contribute 3.1 percent of the original 2013 category TRI TWPE. Therefore, EPA did not review hydroquinone releases as part of the 2015 Annual Review.
[b] Number of facilities with TWPE greater than zero.

3.10.3 OCPSF Category PACs Discharges in DMR and TRI

EPA reviewed 2013 DMR and TRI PACs discharges from OCPSF facilities for the 2015 Annual Review. EPA's investigation of the 2013 DMR PACs data revealed that two facilities, Honeywell International, Inc. (Honeywell), in Hopewell, VA, and E. I. DuPont de Nemours in Washington, WV, account for 94 percent of the 2013 DMR PACs discharges, which consist of benzo[a]pyrene and benzo[k]fluoranthene[32] discharges (shown in Table 3-82). EPA did not investigate the remaining facilities discharging benzo[a]pyrene, benzo[k]fluoranthene or other PACs as part of the 2015 Annual Review.

[32] Benzo[a]pyrene and benzo[k]fluoranthene are PACs. Facilities submit DMR data for individual PACs. In TRI, facilities report PACs as a chemical category.

Table 3-82. Top 2013 DMR PACs Discharging Facilities

Facility Name	Facility Location	Benzo[a]pyrene			Benzo[k]fluoranthene		
		Pounds Discharged	TWPE	Percent of Category TWPE	Pounds Discharged	TWPE	Percent of Category TWPE
Honeywell International, Inc. Hopewell Plant	Hopewell, VA	322	32,400	54%	322	9,870	54%
E. I. DuPont de Nemours - Washington Works	Washington, WV	240	24,200	40%	240	7,360	40%
All other pollutant dischargers in the OCPSF Category[a]		32.1	3,230	6%	31.7	971	6%
Total		**594**	**59,800**	**100%**	**594**	**18,200**	**100%**

Source: *DMRLTOutput2013_v1.*
Note: Sums of individual values may not equal the total presented, due to rounding.
[a] Ten additional facilities submitted benzo[a]pyrene discharges in the 2013 DMR data. Seven additional facilities submitted benzo[k]fluoranthene discharges in the 2013 DMR data.

EPA's investigation of the 2013 TRI PACs releases revealed that two facilities, Sasol North America Inc. Lake Charles Chemical Complex (Sasol), in Westlake, LA and ExxonMobil Chemical Co. Baytown Olefins Plant (ExxonMobil), in Baytown, TX, account for 96 percent of the 2013 TRI PACs releases (as shown in Table 3-83 below). EPA did not investigate the remaining facilities releasing PACs as part of the 2015 Annual Review.

Table 3-83. Top Facilities Reporting 2013 TRI PACs Releases

Facility Name	Facility Location	Pounds of Pollutant Released	Pollutant TWPE	Percent of Category TWPE
Sasol North America, Inc. Lake Charles Chemical Complex	Westlake, LA	123	12,300	76%
ExxonMobil Chemical Co. Baytown Olefins Plant	Baytown, TX	33	3,320	20%
All other PACs releases in the OCPSF Category[a]		6.54	658	4%
Total		**162**	**16,300**	**100%**

Source: *TRILTOutput2013_v1.*
Note: Sums of individual values may not equal the total presented, due to rounding.
[a] Seven additional facilities reported PACs releases in the 2013 TRI.

Honeywell International Inc. Hopewell Plant

The Honeywell International Hopewell, VA plant discharges benzo[a]pyrene and benzo[k]fluoranthene from outfall 101, which discharges contact cooling water from two barometric condensers (VA DEQ, 2008). After EPA downloaded the 2013 DMR data from the DMR Loading Tool for the 2015 Annual Review, the facility subsequently updated their DMR data to add a below-detection-limit code to their reports of benzo[a]pyrene and benzo[k]fluoranthene, indicating that loads for these pollutants should be zero. Therefore, EPA zeroed the benzo[a]pyrene and benzo[k]fluoranthene discharges for the facility, which decreased the OCPSF benzo[a]pyrene TWPE from 59,800 to 27,400, and benzo[k]fluoranthene TWPE from 18,200 to 8,330. These corrections are reflected in Table 3-80.

E. I. DuPont de Nemours - Washington Works

E. I. DuPont de Nemours – Washington Works, in Washington, WV, discharges benzo[a]pyrene and benzo[k]fluoranthene from outfalls 002, 005, and 105. As part of the 2015 Annual Review, EPA verified the 2013 DMR data with the West Virginia Department of Environmental Protection (WV DEP). The facility's DMRs (from WV DEP) indicated that all benzo[a]pyrene and benzo[k]fluoranthene discharges were below the detection limit in 2013. Therefore, EPA zeroed the facility's benzo[a]pyrene and benzo[k]fluoranthene discharges, further decreasing the OCPSF benzo[a]pyrene TWPE to 3,230 and the benzo[k]fluoranthene TWPE to 971. These corrections are reflected in Table 3-80.

Sasol North America Inc. Lake Charles Chemical Complex

Sasol is an organic chemical manufacturing plant in Westlake, LA. EPA previously reviewed this facility as part of the 2011 and 2013 Annual Reviews. Sasol discharges process wastewater, stormwater, sanitary wastewater, and miscellaneous utility wastewaters through eight outfalls. The facility's 2009 NPDES permit includes limits for 5 PACs compounds[33] (LA DEQ, 2009a). Because Sasol plans to approximately triple the company's chemical production capacity from 2015 to 2018 (Sasol, 2015), a revised permit was issued for the facility in 2014. The revised permit includes four phases of pollutant limits, including PACs, as construction progresses at the site.[34] The pollutant limits are more stringent for each phase of construction, requiring the facility to meet the most stringent limits in 2018, when expansion is scheduled to be completed (LA DEQ, 2014).

As part of the 2015 Annual Review, EPA contacted the facility. The contact stated that Sasol's TRI PACs releases are based on the samples taken for their NPDES permit and that increases in the load released are due to an increase in flow from increased production and rainfall (Shaw, 2014). EPA reviewed 2013 DMR PACs discharges for Sasol, shown in Table 3-84, and determined that all discharges are below the 2009 permit limits. Even though the facility plans to increase production capacity in future years, the facility's PACs discharges may decrease due to the more stringent limits included in the facility's revised permit.

Table 3-84. Sasol's 2013 DMR PACs Discharges

PACs	Outfall	Date	Flow (MGD)	Reported Quantity (kg/day)	Calculated Quantity (lb/day)	2009 NPDES Monthly Average Permit Limit (lb/day)
Benzo(a)anthracene	001	31-Mar-13	2.11	0	0	0.164
	001	30-Jun-13	2.77	0.041	0.090	0.164
	001	30-Sep-13	2.57	0	0	0.164
	001	31-Dec-13	2.34	0	0	0.164
Benzo(a)pyrene	001	31-Mar-13	2.11	0	0	0.164
	001	30-Jun-13	2.77	0.041	0.090	0.164

[33] Benzo(a)anthracene, benzo(a)pyrene, benzo(k)fluoranthene, benzo(b)fluoranthene, and dibenzo(a,h)anthracene.

[34] The monthly average permit limits during the four phases of construction for benzo(a)anthracene and benzo(a)pyrene are each: phase 1 – 0.164 lb/day, phase 2 – 0.0578 lb/day, phase 3 – 0.0289 lb/day, phase 4 – 0.0211 lb/day (LA DEQ, 2014).

Table 3-84. Sasol's 2013 DMR PACs Discharges

PACs	Outfall	Date	Flow (MGD)	Reported Quantity (kg/day)	Calculated Quantity (lb/day)	2009 NPDES Monthly Average Permit Limit (lb/day)
	001	30-Sep-13	2.57	0	0	0.164
	001	31-Dec-13	2.34	0	0	0.164

Source: *DMRLTOutput2013_v1*, LA DEQ, 2009a.

ExxonMobil Chemical Co. Baytown Olefins Plant

EPA has not reviewed TRI PACs releases from ExxonMobil in Baytown, TX, as part of recent annual reviews. As part of the 2015 Annual Review, EPA contacted the facility to discuss PACs releases. The facility contact confirmed the reported 2013 TRI PACs releases and stated that the releases were calculated based on a measured flow from their stormwater outfall multiplied by half the detection limit of three PACs[35] that may be present in the wastewater. The facility contact stated that the PACs releases were calculated to provide a conservative estimate; however, the facility reevaluated this approach and determined that there was no reason to conclude PACs are released at this outfall, because the site's stormwater has no contact with process areas. Beginning with the 2014 reporting year, the facility plans to report zero PACs wastewater releases to TRI (Brewer, 2015).

Table 3-85 presents the TRI PACs releases from 2009 through 2013. The facility contact confirmed the variation in PACs releases from 2009 through 2013 was due to variation in flow. The facility's NPDES permit does not require monitoring of PACs; therefore, the facility does not submit PAC discharges on their DMRs (Brewer, 2015). Based on the information provided by the facility contact, EPA expects a decrease in PACs releases reported to TRI from this facility.

Table 3-85. ExxonMobil's PACs TRI Releases, 2009 – 2013

Year	Pounds of PAC Released	PACs TWPE
2009	50	5,000
2010	56	5,640
2011	19	1,910
2012	54	5,440
2013	33	3,320

Source: *DMRLTOutput2013_v1;* DMR Loading Tool.

3.10.4 OCPSF Category Total Residual Chlorine Discharges in DMR

Ninety-seven facilities submitted DMRs with total residual chlorine discharges in 2013. EPA previously reviewed total residual chlorine discharges from OCPSF facilities as part of the 2010 and 2013 Annual Reviews. As part of the 2010 review, EPA determined that a flow measurement error from one facility resulted in an elevated TWPE; as part of the 2013 review, EPA determined that discharges from the top facility were from an internal outfall, not an external outfall. For these reasons, as part of the 2010 and 2013 Annual Reviews, EPA determined that further review of total residual chlorine discharges was not warranted. Total

[35] Benzo(a)anthracene, benzo(a)pyrene, and chrysene.

residual chlorine is not regulated under the OCPSF ELGs. As shown in Table 3-80, the DMR discharges of total residual chlorine decreased by over 10,000 TWPE (over 17 percent) from 2011 to 2013, and the number of facilities with discharges also decreased.

EPA's investigation of the total residual chlorine discharges revealed that four facilities, Equistar Chemicals, in Channelview, TX; Bayer MaterialScience, in New Martinsville, WV; INEOS USA Green Lake Plant, in Port Lavaca, TX; and Goodyear Tire and Rubber Co., in Beaumont, TX; account for over 60 percent of the 2013 DMR total residual chlorine discharges (as shown in Table 3-86, below). EPA reviewed the DMR data submitted by these four facilities and did not identify any outliers or potential errors. All facilities met permit requirements in 2013: Bayer MaterialScience has monitoring requirements, while the other three facilities met minimum total residual chlorine permit limits.

EPA did not conduct a facility-level review of the remaining 93 facilities discharging total residual chlorine as part of the 2015 Annual Review, as none of the remaining 93 individual facilities accounted for more than 5,000 TWPE; however, a large number of facilities reported total residual chlorine discharges on DMRs in 2013 and the data suggest that three of the top four facilities have minimum total residual chlorine limits in their permits.

Table 3-86. Top 2013 DMR Total Residual Chlorine Discharging Facilities

Facility Name	Facility Location	Pounds of Pollutant Discharged	Pollutant TWPE	Percent of Category TWPE
Equistar Chemicals	Channelview, TX	18,900	9,440	19%
Bayer MaterialScience	New Martinsville, WV	18,000	9,000	18%
INEOS USA Green Lake Plant	Port Lavaca, TX	12,200	6,110	12%
Goodyear Tire & Rubber Co.	Beaumont, TX	10,300	5,160	11%
All other total residual chlorine dischargers in the OCPSF Category[a]		39,000	19,500	40%
Total		**98,400**	**49,200**	**100%**

Source: *DMRLTOutput2013_v1*.
Note: Sums of individual values may not equal the total presented, due to rounding.
a 93 additional facilities submitted total residual chlorine discharges in the 2013 DMR data.

3.10.5 OCPSF Category Hexachlorobenzene Discharges in DMR

EPA's investigation of the hexachlorobenzene discharges revealed that two facilities, Sasol, in Westlake, LA, and Nalco Company, in Garyville, LA, account for 93 percent of the 2013 TRI hexachlorobenzene discharges (as shown in Table 3-87 below). EPA did not investigate the remaining facilities discharging hexachlorobenzene as part of the 2015 Annual Review.

Table 3-87. Top 2013 DMR Hexachlorobenzene Discharging Facilities

Facility Name	Facility Location	Pounds of Pollutant Discharged	Pollutant TWPE	Percent of Category TWPE
Sasol NA, Inc., Lake Charles Chemical Complex	Westlake, LA	8.28	16,100	56%
Nalco Company	Garyville, LA	5.48	10,700	37%
All other hexachlorobenzene dischargers in the OCPSF Category[a]		1.04	2,020	7%
Total		**14.8**	**28,800**	**100%**

Source: *DMRLTOutput2013_v1*.
Note: Sums of individual values may not equal the total presented, due to rounding.
a Eight additional facilities submitted hexachlorobenzene discharges in the 2013 DMR data.

Sasol North America, Inc. Lake Charles Chemical Complex

As discussed in Section 3.10.3, Sasol is an organic chemical manufacturing plant in Westlake, LA. Sasol discharges hexachlorobenzene from outfall 001, which is a continuous discharge of process wastewater, process area stormwater, and miscellaneous utility wastewaters.[36] The facility's 2009 NPDES permit includes limits for hexachlorobenzene of 0.005 lb/day monthly average and 0.012 lb/day daily maximum for outfall 001 (LA DEQ, 2009a). EPA reviewed 2013 DMR hexachlorobenzene discharges for Sasol (shown in Table 3-88) and determined that the June 2013 hexachlorobenzene discharge from outfall 001 is above the 2009 hexachlorobenzene permit limit for outfall 001. However, as shown in Table 3-89, Sasol's DMR hexachlorobenzene discharges from 2010 through 2014 have decreased. Additionally, Sasol's revised 2014 permit includes four phases of hexachlorobenzene limits, which are increasingly more stringent as construction progresses at the site through 2018[37] (LA DEQ, 2014). Even though the facility plans to increase production capacity in future years, the facility's hexachlorobenzene discharges may decrease due to the more stringent limits included in the facility's revised permit.

Table 3-88. Sasol's 2013 DMR Hexachlorobenzene Discharges

Outfall	Date	Flow (MGD)	Reported Quantity (kg/day)	Calculated Quantity (lb/day)	2009 NPDES Monthly Average Permit Limit (lb/day)
001	31-Mar-13	2.11	0	0	0.005
001	30-Jun-13	2.77	0.041	0.09	0.005

36 Process wastewater, process area stormwater, and miscellaneous utility wastewaters are from the Normal Paraffin Unit, Ethoxylate Unit, Alcohol Unit, Alumina Unit, Linear Alkyl Benzene Unit, Ethylene Unit, Steam Plant, Georgia Gulf Lake Charles Vinyl Chloride Monomer Plant, and Activated Sludge Unit. Other wastewaters discharged through outfall 001 include sanitary wastewater, groundwater, holding ponds/basins stormwater, zeolite regeneration wastewater, boiler blowdown, sulfide caustic, lime settler wastewater, caustic wash quench settler blowdown, benzene contaminated water and steam condensate, and alcohol quench wastewater (LA DEQ, 2009a).

37 The monthly average permit limits during the four phases of construction for hexachlorobenzene are: phase 1 – 0.0049 lb/day, phase 2 – 0.0017 lb/day, phase 3 – 0.0009 lb/day, phase 4 – 0.00006 lb/day. The daily maximum permit limits during the four phases of construction for hexachlorobenzene: phase 1 – 0.012 lb/day, phase 2 – 0.0041 lb/day, phase 3 – 0.0021 lb/day, phase 4 –0.0015 lb/day (LA DEQ, 2014).

Table 3-88. Sasol's 2013 DMR Hexachlorobenzene Discharges

Outfall	Date	Flow (MGD)	Reported Quantity (kg/day)	Calculated Quantity (lb/day)	2009 NPDES Monthly Average Permit Limit (lb/day)
001	30-Sep-13	2.57	0	0	0.005
001	31-Dec-13	2.34	0	0	0.005

Source: *DMRLTOutput2013_v1*, LA DEQ, 2009a.

Table 3-89. Sasol's Hexachlorobenzene DMR Discharges, 2010 – 2014

Year	Pounds of Hexachlorobenzene Discharged	Hexachlorobenzene TWPE
2010	28.3	55,200
2011	20.4	39,900
2012	25.8	50,400
2013	8.28	16,100
2014	8.27	16,100

Source: *DMRLTOutput2013_v1;* DMR Loading Tool.

Nalco Company

Nalco Company discharges hexachlorobenzene from outfall 001. The outfall has a continuous discharge of treated process wastewater[38] (LA DEQ, 2009b). EPA previously reviewed hexachlorobenzene discharges from this facility as part of the 2011 Annual Review and determined that the reported daily maximum and monthly average concentrations do not exceed the hexachlorobenzene limits in the facility's permit (U.S. EPA, 2012). The facility's permit requires that the quantity of hexachlorobenzene discharged be reported annually (LA DEQ, 2009b). Table 3-90 presents Nalco's 2013 DMR hexachlorobenzene discharges and associated permit limits. As shown, the reported daily maximum and monthly average quantities do not exceed the hexachlorobenzene limits in the facility's permit.

Table 3-90. 2013 DMR Hexachlorobenzene Discharges for Nalco Company

	2013 DMR Data		Permit Limits	
	Flow (MGD)	Quantity (kg/day)	Pounds (lb/day)	Calculated Quantity (kg/day)
Daily Maximum	0.41	0.0068	0.1	0.0454
Monthly Average	0.41	0.0068	0.05	0.0227

Source: LADEQ, 2009b, *DMRLTOutput2013_v1*.

3.10.6 OCPSF Category Dioxin Discharges in DMR and TRI

EPA reviewed 2013 DMR and TRI data on dioxin and dioxin-like compounds from OCPSF facilities for the 2015 Annual Review. EPA's investigation of the 2013 DMR dioxin data revealed that one facility, A.K.A. Solutia Nitro Site (Solutia), in Nitro, WV, accounts for over 99

[38] Treated process wastewater results from the following areas: acrylamide manufacturing, emulsion polymerization, general purpose reactors and blenders, Kathon™/glutaraldehyde blends, storage and cleaning, Evonik polymer, and the lab. Process area stormwater, utility wastewaters from cooling tower blowdown, boiler blowdown, and water demineralizer, coagulants and cleaners wastewater, and treated sanitary wastewater are also discharged through outfall 001 (LA DEQ, 2009b).

percent of the 2013 DMR 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD)[39] discharges (as shown in Table 3-91).

Table 3-91. Top 2013 DMR TCDD Discharging Facilities

Facility Name	Facility Location	Pounds of Pollutant Discharged	Pollutant TWPE	Percent of Category TWPE
A.K.A. Solutia Nitro Site	Nitro, WV	0.0000359	25,200	99.9%
The Dow Chemical Company	Midland, MI	3.50×10^{-9}	2.46	0.01%
Total		**0.0000359**	**25,200**	**100%**

Source: *DMRLTOutput2013_v1.*
Note: Sums of individual values may not equal the total presented, due to rounding.

EPA's investigation of the 2013 TRI dioxin and dioxin-like compounds releases revealed that two facilities, Sasol, in Westlake, LA, and Dow Chemical, in Midland, MI, account for 93 percent of the 2013 TRI dioxin and dioxin-like compound releases (as shown in Table 3-92 below). EPA did not investigate the remaining facility, Shell Chemical, in Deer Park, TX, releasing dioxin and dioxin-like compounds as part of the 2015 Annual Review.

Table 3-92. Top Facilities Reporting 2013 TRI Dioxin and Dioxin-like Compound Releases

Facility Name	Facility Location	Pounds of Pollutant Released	Pollutant TWPE	Percent of Category TWPE
Sasol NA, Inc. Lake Charles Chemical Complex	Westlake, LA	0.00107	53,700	77%
The Dow Chemical Company	Midland, MI	0.00408	11,100	16%
Shell Chemical	Deer Park, TX	0.00170	4,870	7%
Total		**0.00685**	**69,700**	**100%**

Source: *TRILTOutput2013_v1.*
Note: Sums of individual values may not equal the total presented, due to rounding.

A.K.A. Solutia Nitro Site

Solutia's Nitro Site is an active remedial construction site. The TCDD discharges at the site are a result of byproducts created by the production of the herbicide 2, 4, 5-trichlorophenoxyacetic acid at the site from 1948 to 1969. As part of the 2015 Annual Review, EPA contacted Solutia about the facility's TCDD discharges. The facility contact stated that they are implementing remediation activities under a RCRA corrective action permit, which includes capping and covering areas with TCDD-affected soils, and pumping and treating groundwater from the affected area on site. Remediation activities were scheduled to be completed in summer 2015 (House, 2014). The facility's DMR TCDD TWPE decreased from 25,200 in 2013 to 4,950 in 2014. The facility contact stated that TCDD discharges are expected to cease with the completion of the remediation activities (House, 2014). Because the facility is implementing

[39] TCDD is a dioxin compound. Facilities can submit DMR data for individual dioxin compounds. In TRI, facilities report dioxin compounds as the group of dioxin and dioxin-like compounds.

remediation activities, EPA expects the TCDD discharges to continue to decrease on future DMRs.

The Dow Chemical Company

Dow Chemical in Midland, MI, is a large chemical manufacturing facility and discharges dioxin and dioxin-like compounds from outfall 031. The facility is a top TRI discharger of dioxin and dioxin-like compounds in the OCPSF Category (as shown in Table 3-92).

EPA previously reviewed TRI dioxin and dioxin-like compound discharges from Dow Chemical as part of the 2009 Annual Review and determined that such discharges mostly resulted from historical processes. As part of the 2015 Annual Review, EPA contacted the facility to discuss its dioxin and dioxin-like compound discharges. The facility contact confirmed the 2013 TRI dioxin and dioxin-like compound discharges and stated that they were calculated from measured concentrations from bi-weekly wastewater composite samples using EPA Method 1613B (non-detect concentrations were treated as zero). The facility contact indicated that discharges are from historical processes and waste management units that are no longer in operation at the site (Kennett, 2015). Although TRI releases are based on sampling data, they are significantly higher than discharges submitted on the facility's DMRs. Table 3-93 presents TRI dioxin and dioxin-like compound discharges for Dow Chemical from 2008 through 2013. As shown, discharges ranged from 6,740 to 13,200 TWPE over those 6 years.

Table 3-93. Dow Chemical Company TRI Dioxin and Dioxin-like Compound Releases, 2008 – 2013

Year	Dioxin and Dioxin-like Compound TWPE
2008	11,300
2009	6,740
2010	13,200
2011	9,500
2012	8,890
2013	11,100

Source: *TRILTOutput2013*_v1, DMR Loading Tool.

Sasol North America Inc. Lake Charles Chemical Complex

EPA has previously reviewed TRI dioxin and dioxin-like compound releases from Sasol as part of the 2011 and 2013 Annual Reviews. As part of these reviews, the facility contact stated that the dioxin and dioxin-like compound distribution is based on an average of 12 different samples at the facility, and all non-detect results are equal to one half of the method detection limit. EPA revised the 2009 and 2011 dioxin loads based on the dioxin and dioxin-like compound distribution provided by the facility by zeroing the non-detect results (U.S. EPA, 2012 and 2014). As part of the 2015 Annual Review, the facility contact confirmed that the method of determining the TRI dioxin and dioxin-like compound release at the facility had not changed (Shaw, 2014). Therefore, EPA corrected the 2013 dioxin load similar to previous years by zeroing the non-detect results. Table 3-94 presents original and corrected pounds of dioxin and dioxin-like compound releases from 2009 through 2013. Incorporating this correction decreases the TRI dioxin and dioxin-like compound TWPE for the OCPSF category from 69,700 to 22,500, as shown in Table 3-81.

Table 3-94. Sasol's Dioxin and Dioxin-like Compound TRI Releases, 2009 – 2013

Year	Original Pounds Discharged	Corrected Pounds Discharged
2009	0.000890	0.0006
2010	0.000898	0.000898[a]
2011	0.000912	0.0006
2012	0.000943	0.000943[a]
2013	0.00107	0.0007

Source: DMR Loading Tool; U.S. EPA, 2012, U.S. EPA 2014

a EPA did not review 2010 or 2012 dioxin and dioxin-like compound discharges for this facility; therefore, discharges were not corrected.

3.10.7 OCPSF Category Carbon Disulfide Releases in TRI

EPA's investigation of carbon disulfide releases revealed that three facilities, Viskase Corp., in Loudon, TN, Innovia Films, Inc., in Tecumseh, KS, and Viscofan USA, Inc., in Danville, IL, account for 97 percent of the 2013 TRI carbon disulfide releases (as shown in Table 3-95). EPA did not investigate the remaining facilities releasing carbon disulfide as part of the 2015 Annual Review.

Table 3-95. Top Facilities Reporting 2013 TRI Carbon Disulfide Releases

Facility Name	Facility Location	Pounds of Pollutant Released	Pollutant TWPE	Percent of Category TWPE
Viskase Corporation	Loudon, TN	35,400	99,000	63%
Innovia Films, Inc.	Tecumseh, KS	10,500	29,300	19%
Viscofan USA, Inc.	Danville, IL	8,800	24,600	16%
All other carbon disulfide releases in the OCPSF Category[a]		1,550	4,340	3%
Total		56,200	157,000	**100%**

Source: *TRILTOutput2013_v1*.

Note: Sums of individual values may not equal the total presented, due to rounding.

a Seven additional facilities reported carbon disulfide releases in the 2013 TRI.

Viskase Corporation

The Viskase Corporation in Loudon, TN, is a food casings manufacturer, one of two facilities operated by Viskase Corporation, the world's largest producer of small-sized food casings (U.S. EPA, 2011b). Viskase Corporation's reported indirect releases of carbon disulfide account for 63 percent of the 2013 TRI OCPSF carbon disulfide TWPE. As shown in Table 3-96 below, releases reported in 2012 and 2013 are substantially greater than releases reported from 2008 through 2011.

EPA reviewed 2006 through 2009 indirect releases from Viskase Corporation in 2011 as part of its *Preliminary Study of Carbon Disulfide Discharges from Cellulose Products Manufacturers* (U.S. EPA, 2011b). Specifically, EPA contacted Viskase Corporation and the local pretreatment coordinator to confirm the carbon disulfide releases. At the time, EPA determined that the majority of the carbon disulfide concentrations measured at the POTW influent did not exceed the industrial user permit limit for carbon disulfide of 5 mg/L. More importantly, the concentrations reviewed were prior to treatment through the receiving POTW. EPA determined that the carbon disulfide concentrations in the POTW effluent following treatment are likely below levels of detection, and are likely no concern to human health and aquatic life. See Section 5.2 of EPA's *Preliminary Study of Carbon Discharge Discharges from Cellulose Products Manufacturers* for more information (U.S. EPA, 2011b).

Similar to its 2007 through 2011 releases, the facility reported that the 2012 and 2013 releases are based on periodic or random monitoring data or measurements. As part of the 2015 Annual Review, EPA made several attempts to contact Viskase Corporation to confirm the findings from its 2011 preliminary study and understand why the carbon disulfide releases increased by an order of magnitude from 2011 to 2012, and then nearly doubled in 2013, but the facility did not respond to the requests (Yoder, 2014). Based on conclusions from the 2011 preliminary study, EPA determined that the carbon disulfide discharges volatilize and likely do not pass through to the POTW effluent.

Table 3-96. Viskase Corporation Carbon Disulfide TRI Indirect Releases, 2007 – 2013

Year	Total Indirect Pounds	Total Indirect TWPE
2007	428	1,200
2008	1,920	5,380
2009	2,080	5,820
2010	2,080	5,820
2011	1,920	5,380
2012	19,000	53,300
2013	35,400	99,000

Source: *TRILTOutput2013_v1;* DMR Loading Tool.

Innovia Films, Inc.

Innovia Films, Inc., in Tecumseh, KS, manufactures cellophane used primarily in food packaging. Innovia reported direct releases of carbon disulfide accounting for 19 percent of the 2013 TRI OCPSF carbon disulfide TWPE. Reported TRI releases from the facility peaked in 2009, decreased in 2010, and were relatively consistent between 2010 and 2013 (as shown in Table 3-97). The facility reported that 2007 through 2013 TRI release estimates are based on periodic or random monitoring data or measurements. The facility also has a NPDES permit (KS0003204) and reports carbon disulfide releases on DMRs. Table 3-97 shows a comparison of the TRI and DMR discharge data for 2007 through 2013. As shown in the table, TRI releases have remained fairly consistent from 2010 through 2013, while DMR discharges have significantly decreased. Therefore, EPA is unsure of the representativeness of the facility's carbon disulfide releases reported to TRI.

EPA reviewed the facility's NPDES permit as part of the *Preliminary Study of Carbon Disulfide Discharges from Cellulose Products Manufacturers* (U.S. EPA, 2011b). From this review, EPA determined that the facility recovers volatilized carbon disulfide, a valuable feedstock, using steam. Some carbon disulfide is captured in the steam condensate and is transferred to the wastewater treatment system. At this facility, the sampling point is more than one mile away from the wastewater treatment system's final discharge point. As a result, during the study EPA determined that the concentration of carbon disulfide entering the surface water is likely lower than sampled because of this distance and volatilization (U.S. EPA, 2011b). The

TRI releases have declined slightly since the 2011 preliminary study, while the DMR discharges have decreased substantially since the 2011 preliminary study, and the actual concentration of carbon disulfide entering the surface water is likely lower than measured by sampling (because of the distance between sampling and outfall, and volatilization).

Table 3-97. Innovia Films Inc. Carbon Disulfide DMR and TRI Releases, 2007 – 2013

Year	Total TRI Pounds	DMR Pounds
2007	5,440	No data available
2008	19,900	12,900
2009	26,500	28,200
2010	10,500	10,200
2011	14,000	7,130
2012	11,000	2,380
2013	10,500	973

Source: *TRILTOutput2013_v1; DMRLTOutput2013_v1;* DMR Loading Tool.

Viscofan USA, Inc.

Viscofan USA, Inc., in Danville, IL, manufactures food casings. The facility reported indirect releases of carbon disulfide accounting for 16 percent of the 2013 TRI OCPSF carbon disulfide TWPE. Table 3-98 presents the facility's carbon disulfide TRI releases from 2007 through 2013. The facility reported that their TRI release estimates are based on periodic or random monitoring data or measurements, but has not responded to EPA's requests for confirmation and details (Webster, 2014). The facility has an active NPDES permit, but does not monitor for carbon disulfide. The reported releases of carbon disulfide from Viscofan USA are to POTWs. Similar to the findings discussed for Viskase above, EPA determined that the carbon disulfide discharges volatilize and likely do not pass through to the POTW effluent.

Table 3-98. Viscofan USA, Inc. Carbon Disulfide TRI Indirect Releases, 2007 – 2013

Year	Total Indirect Pounds	Total Indirect TWPE
2007	1,600	4,480
2008	3,840	10,800
2009	2,240	6,270
2010	9,280	26,000
2011	7,880	22,100
2012	9,920	27,800
2013	8,800	24,600

Source: *TRILTOutput2013_v1;* DMR Loading Tool.

3.10.8 OCPSF Category Nitrate Compounds Releases in TRI

EPA's investigation of the nitrate compounds releases revealed that two facilities, DSM Chemicals NA, Inc., in Augusta, GA, and DuPont Chambers Works, in Deepwater, NJ, together account for 38 percent of the 2013 TRI nitrate compounds releases (as shown in Table 3-99 below). EPA did not conduct facility-level reviews for any of the remaining 119 facilities releasing nitrate compounds in TRI as part of the 2015 Annual Review because none of them contributes more than 1,000 TWPE to the total nitrate TRI TWPE for the OCPSF Category.

Table 3-99. Top Facilities Reporting 2013 TRI Nitrate Compound Releases

Facility Name	Facility Location	Pounds of Pollutant Released	Pollutant TWPE	Percent of Category TWPE
DSM Chemicals NA, Inc.	Augusta, GA	4,390,000	3,280	25%
DuPont Chambers Works	Deepwater, NJ	2,320,000	1,730	13%
All other nitrate compound releases in the OCPSF Category[a]		11,000,000	8,220	62%
Total		**17,700,000**	**13,200**	**100%**

Source: *TRILTOutput2013_v1.*
Note: Sums of individual values may not equal the total presented, due to rounding.
[a] 119 additional facilities reported nitrate compound releases in the 2013 TRI.

DSM Chemicals NA, Inc.

DSM Chemicals NA, Inc. produces caprolactum, a monomer used to make nylon fibers. As part of the 2015 Annual Review, EPA contacted DSM Chemicals NA about its 2013 TRI nitrate compounds releases (Connell, 2015). Most of the nitrate releases are generated at the facility's on-site wastewater treatment plant. Oxidation of organic raw materials during production of caprolactum forms ammonia and nitrites. These nitrogen compounds are then oxidized to nitrate compounds by nitrification in the wastewater treatment plant.

The facility estimated the TRI releases based on monitoring data. The facility samples wastewater three times a week from the wastewater treatment plant effluent and calculates a monthly average nitrate concentration. The facility multiplies the monthly nitrate average concentration by the average monthly flow to determine the annual pounds of nitrate compounds released (Connell, 2015). As shown in Table 3-100, the facility's nitrate compound TRI releases have been fairly similar from 2010 through 2013.

Table 3-100. DSM Chemicals NA, Inc. Nitrate Compound TRI Releases, 2010 – 2013

Year	Pounds of Nitrate Compounds Released	Nitrate TWPE
2010	4,510,000	3,370
2011	5,220,000	3,900
2012	4,080,000	3,050
2013	4,390,000	3,280

Source: *TRILTOutput2013_v1;* DMR Loading Tool.

DuPont Chambers Works

DuPont Chambers Works manufactures hundreds of intermediate products for automotive, consumer, and agricultural uses at five different units at its Deepwater, NJ site (Young, 2014), and releases nitrate compounds directly to surface waters. As part of the 2015 Annual Review, EPA contacted DuPont Chambers Works about its 2013 TRI nitrate compounds releases (Northey, 2015). The facility estimated nitrate releases based on mass balance calculations. The facility samples the final effluent for nitrate compounds weekly, using EPA method 300.0. The facility subtracts the source water nitrate concentration from the effluent concentration to get the net concentration contributed by its industrial activity. Nitrate was detected in all 2013 samples (Northey, 2015).

As shown in Table 3-101, the facility's nitrate compounds releases in 2012 and 2013 are about half of the levels reported in 2007 through 2011. According to the facility contact, the decrease in releases was due to process changes on site, resulting in decreased nitrogen loading to the facility's wastewater treatment plant (Northey, 2015).

Table 3-101. DuPont Chambers Works Nitrate Compounds TRI Releases, 2010 – 2013

Year	Pounds of Nitrate Compounds Released	Nitrate TWPE
2007	4,110,000	3,070
2008	5,310,000	3,970
2009	3,210,000	6,430
2010	4,400,000	3,290
2011	4,260,000	3,180
2012	2,460,000	1,840
2013	2,320,000	1,730

Source: *TRILTOutput2013_v1;* DMR Loading Tool.

The individual facility TWPE associated with nitrate discharges across the OCPSF Category appears to be relatively low (less than 3,300); however, a large number of facilities reported nitrate compound release to TRI in 2013.

3.10.9 OCPSF Category Findings

The estimated toxicity of the OCPSF Category discharges resulted primarily from PACs, total residual chlorine, hexachlorobenzene, and dioxin discharges reported on DMRs, and PACs, dioxin and dioxin-like compound, carbon disulfide, and nitrate compound releases reported to TRI. From the 2015 Annual Review, EPA found:

- ***PACs.*** Two facilities, Honeywell, in Hopewell, VA, and E. I. DuPont de Nemours, in Washington, WV, account for 94 percent of the 2013 DMR benzo[a]pyrene and benzo[k]fluoranthene discharges. Additionally, two facilities, Sasol, in Westlake, LA, and ExxonMobil, in Baytown, TX, account for 96 percent of the 2013 TRI PACs releases. The results of EPA's review of PACs discharges were:
  - EPA confirmed that the DMR benzo[a]pyrene and benzo[k]fluoranthene discharges for Honeywell and E. I. DuPont de Nemours were below detection and should be corrected to zero. Incorporating this correction decreases the OCPSF benzo[a]pyrene TWPE from 59,800 to 3,230, and the benzo[k]fluoranthene TWPE from 18,200 to 971.
  - Sasol, in Westlake, LA, is a top facility for 2013 TRI PACs releases. The facility has a NPDES permit, which sets limits for the discharge of five PACs. The TRI data were based on monitoring data for the facility's NPDES permit. The facility is currently meeting its PACs permit limits. In addition, the facility plans to expand from 2015 through 2018, and their revised 2014 NPDES permit has four

phases of increasingly stringent pollutant limits that the facility must meet as construction progresses.

- A facility contact at ExxonMobil, in Baytown, TX, confirmed their 2013 TRI PACs release and stated that the facility based its calculations on conservative estimates of PACs concentrations and that it is not likely that PACs are actually present. As a result, the facility plans to report zero PACs wastewater releases to TRI in future years. Based on the information provided by the facility contact, EPA expects a decrease in PACs releases reported to TRI from this facility.
- For the reasons identified above, EPA has determined that PACs releases for the OCPSF Category do not represent a hazard priority at this time.

- ***Total Residual Chlorine.*** Total residual chlorine is not a regulated pollutant under the OCPSF ELGs. Ninety-seven facilities submitted DMRs with total residual chlorine discharges in 2013; four facilities account for over 60 percent of those discharges. EPA reviewed the DMR data submitted by the top four facilities and found that all four met their permit limits in 2013. In addition, EPA found that three of the facilities had minimum chlorine permit limits. EPA did not conduct a facility-level review of the total residual chlorine discharges for the remaining 93 facilities because no facility individually contributed more than 5,000 TWPE. However, EPA notes that large number of facilities (97 facilities) reported total residual chlorine discharges on DMRs in 2013 and three of the top four facilities reporting total residual chlorine discharges have minimum total residual chlorine limits in their permits.

- ***Hexachlorobenzene.*** Two facilities, Sasol, in Westlake, LA, and Nalco Company, in Garyville, LA, account for 93 percent of the 2013 DMR hexachlorobenzene discharges. EPA determined that hexachlorobenzene discharges from Sasol will likely continue to decrease due to the implementation of more stringent permit limits. Nalco Company's hexachlorobenzene discharges are also below its current permit limits. As a result, EPA determined that hexachlorobenzene discharges for the OCPSF Category do not represent a hazard priority at this time.

- ***Dioxin.*** One facility, Solutia, in Nitro, WV, accounts for over 99 percent of the 2013 DMR TCDD discharges. Two facilities, Sasol, in Westlake, LA, and Dow Chemical, in Midland, MI, account for 93 percent of the 2013 TRI dioxin and dioxin-like compound releases. EPA reviewed the dioxin discharges and found the following:

  - The facility contact at Solutia stated that the facility is implementing remediation activities under a RCRA permit, which includes capping and covering areas with TCDD-affected soils, and pumping and treating groundwater from the affected area on site. TCDD discharges at the site have decreased from 2013 to 2014; the facility expects that the TCDD discharges will cease with the completion of remediation activities, scheduled for summer 2015.
  - EPA identified a data correction for the TRI dioxin and dioxin-like compound releases from Sasol, decreasing the OCPSF category dioxin and dioxin-like compound TRI TWPE from 69,700 to 22,500.
  - The facility contact at Dow Chemical confirmed the 2013 TRI dioxin and dioxin-like compound release data, and stated that the dioxin and dioxin-like compound

releases are from historical processes and waste management units that are no longer in operation at the site.

  - For the reasons identified above, EPA has determined that dioxin discharges for the OCPSF Category do not represent a hazard priority at this time.

- ***Carbon Disulfide.*** Three cellulose products manufacturing facilities, Viskase Corporation, in Loudon, TN, Innovia Films Inc., in Tecumseh, KS, and Viscofan USA Inc., in Danville, IL, account for 97 percent of the 2013 TRI carbon disulfide releases. EPA reviewed the carbon disulfide releases and found the following:
  - EPA reviewed indirect carbon disulfide releases from Viskase Corporation in 2011, as part of the *Preliminary Study of Carbon Disulfide Discharges from Cellulose Products Manufacturers*. Consistent with previous findings, EPA determined that the carbon disulfide discharges likely do not pass through to the POTW effluent.
  - EPA reviewed Innovia Films, Inc.'s NPDES permit in 2011, as part of the *Preliminary Study of Carbon Disulfide Discharges from Cellulose Products Manufacturers*. At the time, EPA determined that the concentration of carbon disulfide entering the surface water is likely lower than sampled because of additional volatilization over the long distance between the sampling point and the wastewater treatment system final discharge point. TRI carbon disulfide discharges at the facility have remained stable from 2010 to 2013, and DMR discharges have decreased substantially from 2010 to 2013; therefore, EPA has continued to find that 2013 TRI discharges are likely lower than sampled.
  - As was the case for Viskase, the reported releases of carbon disulfide from Viscofan USA, Inc., are to POTWs. EPA determined that the carbon disulfide discharges likely do not pass through to the POTW effluent.
  - Only ten facilities reported TRI carbon disulfide releases in 2013 and three constituted 97 percent of the releases (two of these discharge indirectly to POTWs). EPA does not consider the carbon disulfide releases to be representative of the OCPSF category.
- ***Nitrate.*** One hundred twenty-one facilities reported releases of nitrate compounds to TRI in 2013; two facilities, DSM Chemicals NA, Inc., in Augusta, GA, and DuPont Chambers Works, in Deepwater, NJ, account for 38 percent of those releases. EPA confirmed that both facilities base their nitrate compound TRI releases on monitoring data. DSM Chemical's TRI nitrate releases have remained fairly similar from 2010 through 2013, while DuPont Chambers Works' TRI nitrate compound releases have decreased from 2010 through 2013. EPA did not conduct a facility-level review of the remaining 119 facilities with reported TRI nitrate compound releases in 2013, as the majority contribute less than 1,000 TWPE each. However, EPA notes that a large number of facilities (121 facilities) reported nitrate compound releases to TRI in 2013.

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3.11 Pulp, Paper, and Paperboard (40 CFR Part 430)

EPA identified the Pulp, Paper, and Paperboard (Pulp and Paper) Category for preliminary review because it ranks high again, in terms of toxic-weighted pound equivalents (TWPE), in the final 2015 combined point source category rankings. Previously, EPA reviewed discharges from this category as part of the Preliminary and Final Effluent Guidelines Program Plans in 2004–2013 in which it also ranked high (U.S. EPA, 2004, 2006a, 2007, 2008, 2009a, 2011, 2012, 2014a, and 2014b). During its 2006 Effluent Guidelines Program Plan development, EPA also conducted a detailed study of this industry (U.S. EPA, 2006b).

This section summarizes the results of the 2015 Annual Review. EPA focused its 2015 review on discharges of hydrogen sulfide, dioxin and dioxin-like compounds, and manganese and manganese compounds because of their high TWPE relative to other pollutants discharged by facilities in the Pulp and Paper Category. Dioxin and dioxin-like compounds and manganese and manganese compounds, reviewed as part of the 2013 Annual Review, continue to be top pollutants of concern. Hydrogen sulfide was added as a Toxic Release Inventory (TRI) reporting requirement in 2012. As a result, in 2013, hydrogen sulfide contributed a substantial amount of TWPE for the category. Therefore, for the 2015 Annual Review, available discharge data showed substantial contributions of hydrogen sulfide to the Pulp and Paper Category TWPE.

3.11.1 Pulp and Paper Category 2015 Toxicity Rankings Analysis

Table 3-102 compares the toxicity rankings analyses (TRA) data for the Pulp and Paper Category from the 2011, 2013, and 2015 Annual Reviews. EPA did not conduct the TRA in 2012 or 2014, but instead reviewed additional data sources as part of the even-year annual review, as described in Section 2.2.1 of EPA's Preliminary 2016 Plan (U.S. EPA, 2016). As discussed in this section, during the 2015 Annual Review, EPA identified a data correction that affected the 2013 TRI data and TWPE. The bottom row of Table 3-102 shows both the original data and the corrected data resulting from this review.

Table 3-102. Pulp and Paper Category TRI and DMR Facility Counts and Discharges Reported for 2009, 2011, and 2013

Year of Discharge	Year of Review	Pulp and Paper Category Facility Counts[a]			Pulp and Paper Category TWPE		
		Total of TRI Facilities	Total DMR Major Facilities	Total DMR Minor Facilities	TRI TWPE[b]	DMR TWPE[c]	Total
2009	2011	250	137	20	1,080,000	260,000[d]	1,340,000
2011	2013	219	130	24	651,000	576,000[e]	1,230,000
2013	2015	226	110	16	2,750,000 [f] 1,820,000[g]	321,000	3,070,000 [f] 2,140,000[g]

Sources: 2013 Annual Review Report (for 2009 and 2011 DMR and TRI Data) (U.S. EPA, 2014); *DMRLTOutput2013_v1* (for 2013 DMR); *TRILTOutput2013_v1* (for 2013 TRI).

Note: EPA did not evaluate 2010 or 2012 DMR and TRI data

Note: TWPE values are rounded to three significant figures. Sums of individual values may not equal the total presented, due to rounding.

a Number of facilities with TWPE greater than zero.

b Releases include direct discharges to surface waters and transfers to POTWs. Transfers to POTWs account for POTW removals. The 2013 TRI TWPE also includes TWPE associated with reported releases of hydrogen sulfide. Facilities began reporting releases of hydrogen sulfide to TRI in 2012.

c Includes DMR data from both major and minor dischargers.

d 2009 data after corrections were made during the 2011 Annual Review.

e 2011 data after corrections were made during the 2013 Annual Review.

f 2013 data prior to corrections made during the 2015 Annual Review.

g 2013 data after corrections were made during the 2015 Annual Review.

As shown in Table 3-102, the TRI TWPE decreased from 2009 to 2011, then increased substantially from 2011 to 2013 while the number of facilities reporting releases to TRI decreased from 2009 to 2013. The total number of facilities submitting discharge monitoring reports (DMRs) decreased from 2009 to 2013, the DMR TWPE increased from 2009 to 2011 and decreased from 2011 to 2013. The increase in TRI TWPE from 2011 to 2013 can be attributed to new requirements for reporting hydrogen sulfide releases, discussed in the sections below.

3.11.2 Pulp and Paper Category Pollutants of Concern

EPA's 2015 review of the Pulp and Paper Category focused on the 2013 TRI releases because the TRI data dominate the category's combined TWPE. Table 3-103 shows the five pollutants with the highest contribution to the 2013 TRI TWPE. Table 3-103 also presents the 2013 TRI TWPE after EPA corrected an error identified in this preliminary category review (discussed in the sections below). As a point of comparison, Table 3-103 also shows the 2011 TRI facility count and TWPE for these top five pollutants, based on the 2013 Annual Review (U.S. EPA, 2014). Because hydrogen sulfide was added as a TRI reporting requirement in 2012, no hydrogen sulfide releases were reported in 2011.

Hydrogen sulfide, dioxin and dioxin-like compounds, and manganese and manganese compounds contribute over 92 percent of the original 2013 TRI TWPE for the Pulp and Paper Category (prior to corrections discussed below). Sections 3.11.3 through 3.11.5 present EPA's investigation of reported TRI releases of the top three pollutants. EPA did not conduct a facility-level investigation of lead and lead compounds and mercury and mercury compounds, as part of the 2015 Annual Review, because they account for less than 4 percent of the total TRI TWPE.

However, many facilities report lead and lead compound and mercury and mercury compound releases to TRI and individually their TWPE is over 45,000, as shown in Table 3-103.

Table 3-103. Pulp and Paper Category Top TRI Pollutants

	2013 TRI Data			2011 TRI Data	
Pollutant[a]	**Number of Facilities Reporting Pollutant[b]**	**Original TWPE**	**Corrected TWPE**	**Number of Facilities Reporting Pollutant[b]**	**TWPE**
Hydrogen Sulfide	98	1,190,000	1,190,000	NA[c]	NA[c]
Dioxin and Dioxin-Like Compounds	42	1,090,000	158,000	38	238,000
Manganese and Manganese Compounds	112	318,000	318,000	104	266,000
Lead and Lead Compounds	172	47,700	47,700	157	48,000
Mercury and Mercury Compounds	84	46,500	46,500	81	52,700
Top Pollutant Total	**NA**	**2,690,000**	**1,760,000**	**NA**	**605,000**
Pulp and Paper Category Total	**226**	**2,750,000**	**1,820,000**	**219**	**651,000**

Sources: *TRILTOutput2011_v1; TRILTOutput2013_v1*
Note: Sums of individual values may not equal the total presented, due to rounding.
NA: Not applicable.
a Lead and lead compound and mercury and mercury compound releases combined contribute less than 5 percent of the original 2013 category TRI TWPE. Therefore, EPA did not review releases of either pollutant as part of the 2015 Annual Review.
b Number of facilities with TWPE greater than zero.
c Hydrogen sulfide was added as a TRI reporting requirement in 2012; it was not a TRI-listed chemical in 2011.

3.11.3 Pulp and Paper Category Hydrogen Sulfide Releases in TRI

EPA's investigation of the hydrogen sulfide data revealed that seven facilities account for 80 percent of the hydrogen sulfide releases reported to TRI in 2013 (shown in Table 3-104). EPA investigated the top facility, which accounts for more than a quarter of the total hydrogen sulfide releases and double the releases reported by any of the other top reporting facilities. EPA did not review in further detail the hydrogen sulfide releases for the remaining 97 pulp and paper mills as part of the 2015 Annual Review, but instead focused on understanding the presence, fate, and concentrations of hydrogen sulfide in pulp and paper mill effluents.

Table 3-104. Top Facilities Reporting 2013 TRI Hydrogen Sulfide Releases

Facility Name	Facility Location	Pounds of Pollutant Released	Pollutant TWPE	Percent of Category TWPE
Georgia-Pacific, Monticello	Monticello, MS	115,000	323,000	27.2%
Rocktenn	Stevenson, AL	50,600	142,000	11.9%
Alabama River Cellulose LLC	Perdue Hill, AL	45,800	128,000	10.8%
Brunswick Cellulose, Inc.	Brunswick, GA	45,300	127,000	10.7%
Rayonier Performance Fibers Jesup Mill	Jesup, GA	34,600	97,000	8.2%
Georgia-Pacific, Cedar Springs LLC	Cedar Springs, GA	34,000	95,300	8.0%
Georgia-Pacific, Toledo LLC	Toledo, OR	16,100	45,100	3.8%
All other hydrogen sulfide dischargers in the Pulp and Paper Category[a]		82,100	230,000	19.4%
Total		**424,000**	**1,190,000**	**100%**

Source: *TRILTOutput2013_v1*
Note: Sums of individual values may not equal the total presented, due to rounding.
[a] 91 additional facilities reported hydrogen sulfide releases in the 2013 TRI.

As part of the 2015 Annual Review, EPA contacted the American Forest and Paper Association (AF&PA) and the National Council for Air and Stream Improvement (NCASI). AF&PA is the national trade association of the forest, pulp, paper, paperboard, and wood products industry. NCASI is a nonprofit research institute funded by the North American forest products industry, including pulp and paper facilities. AF&PA and NCASI provided information on the presence, fate, and concentrations of hydrogen sulfide in pulp and paper mill effluents. Hydrogen sulfide, one of several forms of reduced sulfur, can occur in pulp and paper mill wastewater primarily from two processes: 1) the use and recovery of sulfur-containing pulping liquors; and 2) biological reduction of sulfate or other oxidized sulfur species in wastewater collection or treatment systems. Because most wastewater treatment systems in the forest products industry use aerobic biological treatment, AF&PA and NCASI suggested that high concentrations of hydrogen sulfide do not occur at pulp and paper mills that properly treat their wastewater. However, according to AF&PA and NCASI, it is possible for trace levels of hydrogen sulfide to be present in some treated effluents. Available data from four pulp mills using aerobic treatment showed hydrogen sulfide removal rates greater than 98 percent, mostly due to oxidation in the wastewater treatment system (Wiegand, 2015).

NCASI collected wastewater samples at 25 pulp and paper mills in the U.S. and Canada for total sulfide concentrations and published the results in 2012 in an NCASI Technical Bulletin (NCASI, 2012; Wiegand 2015). The mills were not a random sample, but were chosen because they had experienced odor-related issues in which sulfide may have been a factor. Therefore, the data represent mills with potentially higher concentrations of sulfide in their wastewater than are likely to be found in the category as a whole. The samples were analyzed using NCASI Method RSC-02.02, which uses direct aqueous injection gas chromatography with a pulsed flame photometric detector. This method measures the concentration of total sulfide in the sample that is volatile at pH 2.5. The data showed that biologically treated final effluent concentrations of total sulfide ranged from non-detect to 0.29 mg/L, with an average concentration of 0.10 mg/L.

Six of the 25 mills sampled had non-detect total sulfide concentrations in their effluent (Wiegand, 2015).

NCASI indicated that measuring low concentrations of hydrogen sulfide is challenging due to its absorptive, adsorptive, photo reactive, volatile, biologically active, and oxidative properties. The hydrogen sulfide data collected for the 25 pulp and paper mills discussed above were based on measurements of total sulfide, as hydrogen sulfide is difficult to measure due to dependencies on pH, temperature, ionic strength, and organic and inorganic complexes. NCASI noted that hydrogen sulfide concentrations in treated mill effluents will be less than total sulfide concentrations, in part due to the likely presence of metal and organic sulfide complexes disassociated during the analytical procedure. In addition, pulp and paper mills typically operate biological treatment plants at a neutral pH of 7, higher than the 2.5 pH at which volatile sulfides are measured by the method described above. Due to these factors, NCASI has suggested that the hydrogen sulfide releases identified in its 2012 report of treated mill effluents may be an overestimate. NCASI also indicated that mills are likely using similar methods to estimate their TRI releases, resulting in estimates reported to TRI that are potentially overestimated (NCASI, 2012; Wiegand, 2015).

In 2015, NCASI developed a new sampling system that may allow measurement of dissolved sulfides in water samples (i.e., sulfide forms passing through a 0.7 μm filter), rather than total sulfides. Because the hydrogen sulfide in effluents is dissolved, accurately measuring dissolved sulfides is more likely to produce a close approximation of actual hydrogen sulfide concentrations than measuring total sulfide. AF&PA and NCASI believe that the new sampling system will mitigate overestimates of hydrogen sulfide concentrations in TRI data (Wiegand, 2015).

As part of the 2015 Annual Review, and to follow up on the specific hydrogen sulfide release data reported to TRI in 2013, AF&PA and NCASI also contacted the Georgia-Pacific mill in Monticello, MS, to discuss their hydrogen sulfide releases. This mill reported the largest releases of hydrogen sulfide in 2013, accounting for more than a quarter of the total hydrogen sulfide releases reported to TRI in 2013 and double the releases reported by any of the other top reporting facilities. The mill confirmed their 2013 TRI hydrogen sulfide release, and stated that this value was based on a direct total sulfide concentration measurement of the treated effluent at the facility. Since 2013, the facility has improved their wastewater treatment system by dredging treatment basins of accumulated solids to increase the available aeration zone, and releases decreased to 32,000 pounds (89,900 TWPE) per year in 2014 (Schwartz and Wiegand, 2014). This value is consistent with the hydrogen sulfide releases reported by the other top reporting facilities. EPA did not review in further detail the hydrogen sulfide releases for the remaining 97 pulp and paper mills, which account for 73 percent of the 2013 TRI hydrogen sulfide releases.

In summary, as discussed above, in 2013, pulp and paper mills may have calculated their hydrogen sulfide releases to TRI using a total sulfide concentration and, according to AF&PA and NCASI, this results in an overestimate. EPA has determined these industry trade associations are actively evaluating discharges from pulp and paper mills and are working on refining methods to improve the accuracy of sampling techniques that will enhance the quality of data reported to TRI in the future.

3.11.4 Pulp and Paper Category Dioxin and Dioxin Compound Releases in TRI

EPA's investigation of the dioxin and dioxin compound data revealed that five facilities account for 93 percent of the dioxin and dioxin-like compound releases reported to TRI in 2013 (shown in Table 3-105). EPA did not investigate the remaining facilities reporting releases of dioxin and dioxin-like compounds as part of the 2015 Annual Review.

Table 3-105. Top Facilities Reporting 2013 TRI Dioxin and Dioxin-Like Compounds Releases

Facility Name	Facility Location	Pounds of Pollutant Released	Pollutant TWPE	Percent of Category TWPE
International Paper Pine Hill Mill	Pine Hill, AL	0.00758	683,000	62.8%
Domtar Paper Co.	Bennettsville, SC	0.00194	226,000	20.7%
Boise White Paper LLC	Wallula, WA	0.000274	52,800	4.8%
Rayonier Performance Fibers LLC	Fernandina Beach, FL	0.00270	31,100	2.9%
Resolute FP US Inc. – Calhoun Operations	Calhoun, TN	0.00133	21,900	2.0%
All other dioxin and dioxin-like compound dischargers in the Pulp and Paper Category[a]		0.103	74,100	6.8%
Total		**0.117**	**1,090,000**	**100%**

Source: *TRILTOutput2013_v1*.
Note: Sums of individual values may not equal the total presented, due to rounding.
[a] 37 additional facilities reported dioxin and dioxin-like releases in the 2013 TRI.

International Paper

International Paper's Pine Hill, AL, facility is a containerboard mill. EPA has not previously reviewed dioxin and dioxin-like compound releases from this facility. As part of the 2015 Annual Review, EPA contacted AF&PA and NCASI about this facility's dioxin and dioxin-like compound releases. AF&PA and NCASI confirmed that the facility inadvertently reported an incorrect dioxin distribution (Schwartz and Wiegand, 2014). Correcting the distribution decreases the facility's dioxin and dioxin-like compound TWPE from 683,000 to 480.

Domtar Paper

As part of the 2011 and 2013 Annual Reviews, EPA reviewed the TRI dioxin and dioxin-like compound releases from Domtar Paper, in Bennettsville, SC, and determined that the number of pounds reported as released was based on one half of the detection limit and that dioxin was not actually detected at the mill. As described in Section 3.2.2.2 in EPA's *Technical Support Document for the Annual Review of Existing Effluent Guidelines and Identification of Potential New Point Source Categories* (2009 Screening-Level Analysis (SLA) Report), EPA zeros the load for the purpose of its screening-level toxicity rankings analysis when all concentrations of a specific pollutant are reported as non-detected values for all monitoring periods (U.S. EPA, 2009b). Therefore, EPA zeroed the 2009 and 2011 TRI dioxin and dioxin-like compound releases for Domtar Paper (U.S. EPA, 2012 and 2014b). Table 3-106 presents

Domtar Paper's dioxin and dioxin-like compound TRI releases for 2009 through 2013. As shown, the 2013 release is similar to previous years. Therefore, without re-contacting the mill, EPA concluded that the 2013 reported dioxin and dioxin-like compound release was based on non-detected values. As in previously years, EPA zeroed Domtar Paper's 2013 dioxin and dioxin-like compound release.

Table 3-106. Domtar Paper Dioxin and Dioxin-Like Compound Releases for 2009 – 2013

Year	Pounds of Dioxin and Dioxin-Like Compounds Released	Dioxin and Dioxin-Like Compound TWPE
2009	0.002	225,000
2010	0.00195	232,000
2011	0.00196	228,000
2012	0.00195	232,000
2013	0.00194	226,000

Source: *TRILTOutput2013_v1;* DMR Loading Tool.

Boise White Paper LLC

EPA previously reviewed discharges from Boise White Paper LLC, in Wallula, WA, as part of the 2011, 2012, and 2013 Annual Reviews. As part of the 2011 and 2012 Annual Reviews, EPA reviewed 2009 TRI data and determined that the mill calculated dioxin releases using actual dioxin test results. EPA also determined that the facility detected concentrations of 2,3,7,8-TCDF above the Method 1613B Minimum Level (ML); however, the concentrations of all other detected congeners were below the method MLs. Since EPA does not know the laboratory specific MLs, it is possible that the results are below the laboratory's MLs and may not be accurate.

As part of the 2015 Annual Review, EPA contacted AF&PA and NCASI about Boise White Paper LLC's TRI dioxin and dioxin-like compound releases. The facility contact provided 2012 through 2014 effluent sampling data, shown in Table 3-107 (Schwartz and Wiegand, 2014). As shown, the detected concentrations are all below the corresponding method MLs. As noted above, since EPA does not know the laboratory specific MLs, it is possible that the results are below the laboratory's MLs and may not be accurate.

The facility contact also stated that the company instituted new reporting conventions in 2012. The changes to reporting conventions included using one half of the sample-specific detection limit when values were not detected. In previous reporting years, all non-detect values were reported as zero (Schwartz and Wiegand, 2014).

Table 3-107. Boise White Paper LLC Dioxin and Dioxin-Like Compound Concentrations

Dioxin Congener Number	Dioxin Congener	Method 1613B ML (pg/L)	2012 (pg/L)	2013 (pg/L)	2014 (pg/L)
1	2,3,7,8-TCDD	10	ND	ND	ND
2	1,2,3,7,8-PeCDD	50	ND	ND	ND
3	1,2,3,4,7,8-HxCDD	50	ND	ND	ND
4	1,2,3,6,7,8-HxCDD	50	ND	ND	ND
5	1,2,3,7,8,9-HxCDD	50	ND	ND	ND
6	1,2,3,4,6,7,8-HpCDD	50	14.5	ND	ND
7	1,2,3,4,6,7,8,9-OCDD	100	95.6	20.8	97.2

Table 3-107. Boise White Paper LLC Dioxin and Dioxin-Like Compound Concentrations

Dioxin Congener Number	Dioxin Congener	Method 1613B ML (pg/L)	2012 (pg/L)	2013 (pg/L)	2014 (pg/L)
8	2,3,7,8-TCDF	10	9.30	ND	7.03
9	1,2,3,7,8-PeCDF	50	3.24	ND	ND
10	2,3,4,7,8-PeCDF	50	5.48	ND	ND
11	1,2,3,4,7,8-HxCDF	50	ND	ND	ND
12	1,2,3,6,7,8-HxCDF	50	3.15	ND	ND
13	1,2,3,7,8,9-HxCDF	50	ND	ND	ND
14	2,3,4,6,7,8-HxCDF	50	ND	ND	ND
15	1,2,3,4,6,7,8-HpCDF	50	ND	ND	ND
16	1,2,3,4,7,8,9-HpCDF	50	ND	ND	ND
17	1,2,3,4,6,7,8,9-OCDF	100	ND	ND	ND
Total			**131**	**20.8**	**104**

Sources: Schwartz & Wiegand, 2014
ND: Non-detect results.

Rayonier Performance Fibers

EPA reviewed TRI dioxin and dioxin-like compound discharges from Rayonier Performance Fibers (Rayonier) in Fernandina Beach, FL, as part of the 2011, 2012, and 2013 Annual Reviews. From these earlier reviews, EPA confirmed that the mill bases its reported dioxin and dioxin-like compound discharges on quarterly measurements (U.S. EPA, 2012). Rayonier reported that they detected seven dioxin congeners in their effluent wastewater in 2009[40] and five in 2011[41]. In both years, two congeners were detected above EPA's Method 1613 MLs; however, EPA concluded that the concentrations were low and that the discharges did not warrant further review (U.S. EPA, 2014a, 2014b).

Similar to previous years, Rayonier reported that they detected seven dioxin congeners in their effluent wastewater in 2015[42]. Table 3-108 presents Rayonier's dioxin and dioxin-like compound TRI releases for 2009, 2011, and 2013. As shown, quantities of these congeners and the TWPE have decreased from 2009 to 2013.

Table 3-108. Rayonier Dioxin and Dioxin-Like Compound Releases for 2009, 2011, 2013

Year	Pounds of Dioxin and Dioxin-Like Compounds Released	Dioxin and Dioxin-Like Compound TWPE
2009	0.011	37,800
2011	0.016	38,900
2013	0.0026	31,100

Source: *TRILTOutput2013_v1;* DMR Pollutant Loading Tool.

[40] Rayonier detected concentrations of 1,2,3,7,8,9-HxCDD; 1,2,3,4,6,7,8-HpCDD; 1,2,3,4,6,7,8,9-OCDD; 2,3,7,8-TCDF; 2,3,4,7,8-PeCDF; 1,2,3,4,6,7,8-HpCDF; and 1,2,3,4,6,7,8,9-OCDF in 2009. See Section 5.3.2 in the 2012 Annual Review Report (U.S.EPA, 2014a).

[41] Rayonier detected concentrations of 1,2,3,4,6,7,8-HpCDD; 1,2,3,4,6,7,8,9-OCDD; 2,3,7,8-TCDF; 1,2,3,4,6,7,8-HpCDF; and 1,2,3,4,6,7,8,9-OCDF in 2011 (U.S. EPA, 2014b).

[42] Rayonier detected concentrations of 1,2,3,7,8-PeCDD; 1,2,3,4,6,7,8-HpCDD; 1,2,3,4,6,7,8,9-OCDD; 2,3,7,8-TCDF; 1,2,3,4,7,8-HxCDF; 1,2,3,4,6,7,8-HpCDF; and 1,2,3,4,6,7,8,9-OCDF in 2013.

Resolute FP US Inc. – Calhoun Operations

EPA reviewed TRI dioxin and dioxin-like compound discharges from Resolute FP US Inc. (Resolute)[43] in Calhoun, TN, as part of the 2011 and 2013 Annual Reviews. As part of these earlier reviews, EPA confirmed that all dioxin congeners were non-detect and zeroed the TRI dioxin and dioxin-like compound releases for the facility. Table 3-109 presents the facility's dioxin and dioxin-like compound TRI releases for 2009, 2011, and 2013. Since the 2013 dioxin and dioxin-like compound discharges are similar to previous years, EPA similarly zeroed them. Zeroing dioxin and dioxin-like compound discharges from Resolute further decreases the Pulp and Paper dioxin and dioxin-like compound TRI TWPE to 158,000, as shown in Table 3-103.

Table 3-109. Resolute Dioxin and Dioxin-Like Compound Releases for 2009, 2011, 2013

Year	Pounds of Dioxin and Dioxin-Like Compounds Released	Dioxin and Dioxin-Like Compound TWPE
2009	0.0015	24,900
2011	0.0016	27,300
2013	0.0013	21,900

Source: *TRILTOutput2013_v1;* DMR Loading Tool.

3.11.5 Pulp and Paper Category Manganese and Manganese Compound Releases in TRI

Manganese and manganese compound discharges account for 14.5 percent of the total 2013 TRI TWPE. Manganese is not a regulated pollutant in the Pulp and Paper effluent limitations guidelines and standards (ELGs). In 2013, 112 facilities reported discharges of manganese and manganese compounds to TRI.

EPA reviewed manganese and manganese compound discharges in detail as part of the 2006 Pulp and Paper Detailed Study. At that time, EPA concluded that manganese and manganese compound discharges in this category are below treatable levels (U.S. EPA, 2006b). More recently, EPA reviewed the TRI manganese and manganese compound discharges for the Pulp and Paper Category as part of the 2011 and 2013 Annual Reviews. During these reviews, EPA compared annual releases reported to TRI to data reviewed as part of the 2006 Pulp and Paper Detailed Study and determined that the releases remained relatively consistent. Therefore, EPA confirmed that its previous conclusion from the 2006 detailed study still applies. As part of the 2011 and 2013 Annual Reviews, however, EPA did not further evaluate manganese concentration data (U.S. EPA, 2012, 2014b).

As part of the 2015 Annual Review, EPA reviewed manganese and manganese compound discharges in TRI from 2002 to 2013 (see Table 3-110). As shown, the discharges are fairly consistent from 2002 to 2013. However, EPA notes that nearly 50 percent of the facilities (112 out of 226 facilities) reporting releases to TRI reported releases of manganese and manganese compounds in 2013 (none contributed more than five percent of the manganese and manganese compound TRI TWPE for the Pulp and Paper Category). EPA has not evaluated manganese concentration data compared to treatable levels since the 2006 detailed study.

[43] This facility is referred to as Abibow US Inc. in previous annual review reports. In 2012, Abibow US Inc. became Resolute FP US Inc. (Resolute, 2012).

Table 3-110. 2002–2013 Manganese and Manganese Compound Releases in TRI

Discharge Year	Review Year	TRI Data	
		Number of Dischargers	Total TWPE
2002	2006	112	304,000
2004	2007	117	316,000
2007	2009	79	231,000
2008	2010	117	308,000
2009	2011	115	298,000
2011	2013	104	266,000
2013	2015	112	318,000

Sources: *TRIReleases2002; PCSLoads2002; TRIReleases2004_v3; PCSLoads2004_v3; TRIReleases2007_v2; DMRLoads2007_v4; TRIReleases2008_v3; DMRLoads2008_v3; TRIReleases2009_v2; DMRLoads2009_v2; DMRLTOutput2011_v1; TRILTOutput2011_v1; DMRLTOutput2013_v1; TRILTOutput2013_v1.*

3.11.6 Pulp and Paper Category Findings

The estimated toxicity of the Pulp and Paper Category discharges resulted primarily from hydrogen sulfide, dioxin and dioxin-like compound, and manganese and manganese-like compound releases reported to TRI. From the 2015 Annual Review, EPA found:

- ***Hydrogen Sulfide.*** Seven facilities account for 80 percent of the TRI hydrogen sulfide releases, with one facility, Georgia-Pacific, in Monticello, MS, accounting for 27 percent of the releases. The Georgia-Pacific facility confirmed the 2013 TRI hydrogen sulfide release data, but stated that wastewater treatment system improvements have led to decreased hydrogen sulfide discharges in 2014.

  EPA identified 97 mills with hydrogen sulfide releases reported to TRI in 2013. Discussions with industry trade associations, AF&PA and NCASI, suggest that pulp and paper mills may calculate their hydrogen sulfide releases to TRI using total sulfide concentrations, which may result in an overestimate. Further, NCASI has developed a new sampling system that may allow measurement of dissolved sulfides, which AF&PA and NCASI believe may lessen the overestimate of hydrogen sulfide releases in TRI.

- ***Dioxin.*** The majority of dioxin and dioxin-like compound releases from the Pulp and Paper Category result from five facilities. Three of the facilities had data changes, resulting in the dioxin and dioxin-like compound TWPE for the Pulp and Paper Category to decrease from 1,090,000 to 158,000. This decreases the 2013 Pulp and Paper Category TWPE from 3,070,000 to 2,140,000. EPA determined the remaining two facilities either had discharges below the method MLs or decreasing discharges in recent years.

- ***Manganese.*** In 2013, 112 facilities reported releases of manganese and manganese compounds with none contributing more than five percent of the 2013 manganese and manganese compound TRI TWPE for the Pulp and Paper Category. Though the releases have been fairly consistent from 2002 to 2013, it has been nearly 10 years since EPA conducted the Pulp and Paper Detailed Study in which it evaluated manganese and manganese compound concentrations compared to treatable levels.

- ***Lead and Mercury***. EPA did not further investigate lead and lead compounds and mercury and mercury compounds as part of the 2015 Annual Review; however, EPA notes that a large number of facilities reported lead and lead compound and mercury and mercury compound releases (172 and 84 facilities, respectively), to TRI in 2013. These pollutants are not regulated by the Pulp and Paper Category ELGs.

3.11.7 Pulp and Paper Category References

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3.12 Textile Mills (40 CFR Part 410)

EPA identified the Textile Mills (Textiles) Category for preliminary review because it ranks high again, in terms of toxic-weighted pound equivalents (TWPE), in the final 2015 combined point source category rankings. Previously, EPA reviewed discharges from this category as part of the 2005, 2006, 2007, 2010, and 2011 Annual Reviews in which it also ranked high (U.S. EPA, 2005, 2006, 2007, 2011, 2012). This section summarizes the results of the 2015 Annual Review. EPA focused its 2015 review on discharges of toxaphene and sulfide because of their high TWPE relative to the other pollutants discharged by facilities in the Textiles Category.

3.12.1 Textiles Category 2015 Toxicity Rankings Analysis

Table 3-111 compares the toxicity rankings analyses (TRA) data for the Textiles Category from the 2011, 2013, and 2015 Annual Reviews. EPA did not conduct the TRA in 2012 or 2014, but instead reviewed additional data sources as part of the even-year annual review, as described in Section 2.2.1 of EPA's Preliminary 2016 Plan (U.S. EPA, 2016). During the 2015 Annual Review, EPA did not identify any data corrections to the 2013 Discharge Monitoring Report (DMR) and Toxic Release Inventory (TRI) discharge data for the Textiles Category.

Table 3-111. Textiles Category TRI and DMR Facility Counts and Discharges Reported in 2009, 2011, and 2013

Year of Discharge	Year of Review	Textiles Category Facility Counts[a]			Textiles Category TWPE		
		Total TRI Facilities	Total DMR Major Facilities	Total DMR Minor Facilities	TRI TWPE[b]	DMR TWPE[c]	Total TWPE
2009	2011	54	35	21	1,910	37,200	39,100
2011	2013	41	27	25	1,070	22,300	23,400
2013	2015	43	29	21	2,210	89,500	91,700

Sources: *TRIReleases2009_v2*, *DMRLoads2009_v2*, and 2011 Annual Review Report (for 2009 DMR data) (U.S. EPA, 2012); *DMRLTOutput2011_v1* (for 2011 DMR); *TRILTOutput2011_v1* (for 2011 TRI); *DMRLTOutput2013_v1* (for 2013 DMR); *TRILTOutput2013_v1* (for 2013 TRI)
Note: EPA did not evaluate 2010 or 2012 DMR and TRI data
Note: TWPE values are rounded to three significant figures. Sums of individual values may not equal the total presented, due to rounding.
a Number of facilities with TWPE greater than zero.
b Releases include direct discharges to surface waters and transfers to POTWs. Transfers to POTWs account for POTW removals.
c Includes DMR data from both major and minor dischargers.

As shown in Table 3-111, the total TWPE increased significantly in 2013, while the number of TRI and major and minor DMR facilities decreased slightly from 2009 to 2013.

3.12.2 Textiles Category Pollutants of Concern

EPA's 2015 review of the Textiles Category focused on the 2013 DMR discharges because the DMR data dominate the category's combined TWPE. Table 3-112 shows the five pollutants with the highest contribution to the 2013 DMR TWPE. As a point of comparison, Table 3-112 shows the 2011 DMR facility count and TWPE for these top five pollutants, based on the 2013 Annual Review (U.S. EPA, 2014).

Toxaphene and sulfide contribute more than 95 percent of the total 2013 DMR TWPE. Of these top pollutants, only sulfide is a regulated pollutant in the Textiles Category effluent limitation guidelines and standards (ELGs) (40 CFR Part 410). EPA's investigations of reported discharges of the top two pollutants are presented in Sections 3.12.3 and 3.12.4. EPA did not investigate the other pollutants, including copper, zinc, and total residual chlorine, as part of the 2015 Annual Review, because they represent a small percentage (4 percent) of the 2013 DMR TWPE for the Textiles Category.

Table 3-112. 2013 Textiles Category Top DMR Pollutants

Pollutant[b]	2013 DMR Data[a]		2011 DMR Data[a]	
	Number of Facilities Reporting Pollutant[c]	TWPE	Number of Facilities Reporting Pollutant[c]	TWPE
Toxaphene	1	48,000	0	0
Sulfide	9	37,600	13	19,200
Copper	13	2,280	9	67.1
Zinc	9	1,330	8	13.1
Total Residual Chlorine	11	110	17	1,170
Top Pollutant Total	**NA**	**89,300**	**NA**	**20,400**
Textiles Category Total	**50**	**89,500**	**52**	**22,300**

Sources: *DMRLTOutput2013_v1* (for 2013 TWPE); *DMRLTOutput2011_v1* (for 2011 TWPE)
Note: Sums of individual values may not equal the total presented, due to rounding.
NA: Not applicable.
a Includes DMR data from both major and minor dischargers.
b Copper, zinc, and total residual chlorine discharges combined contribute 4 percent of the 2013 category DMR TWPE. Therefore, EPA did not review copper, zinc, or total residual chlorine discharges as part of the 2015 Annual Review.
c Number of facilities with TWPE greater than zero.

3.12.3 Textiles Toxaphene Discharges in DMR

EPA's investigation of the toxaphene discharges revealed that one facility, Mohawk Industries Inc. Oak River Facility (Mohawk Industries), in Bennettsville, SC, accounts for 100 percent of the 2013 DMR toxaphene discharges. In 2013, the facility reported 1.59 pounds of toxaphene discharged, corresponding to 48,000 TWPE (*DMRLTOutput2013_v1)*.

Mohawk Industries in Bennettsville, SC, discharges toxaphene from one outfall and submits monthly toxaphene concentrations, presented in Table 3-113. The facility's permit includes a monthly average toxaphene limit of 0.79 micrograms per liter (µg/L), equal to 0.00079 milligrams per liter (mg/L), and a daily maximum toxaphene limit of 17.8 µg/L (0.0178 mg/L) for outfall 001 (Rippy, 2015). EPA reviewed this facility's toxaphene discharges as part of the 2010 Annual Review. The facility contact confirmed that toxaphene is not used as a raw material or in any other chemicals at the facility. However, detectable concentrations have been found in water quality data. Therefore, the South Carolina Department of Health and Environmental Control (SC DHEC) included limitations for toxaphene in the facility's permit (U.S. EPA, 2011). As shown in Table 3-113, the concentrations for June, July, November, and December 2013 are above the facility's monthly average permit limit.

Table 3-113. Mohawk Industries' 2013 DMR Monthly Toxaphene Discharges Reported for Outfall 001

Date	Monthly Average Flow (MGD)	Monthly Average Concentration (mg/L)	NPDES Monthly Average Permit Limit (mg/L)
31-Jan-13	0.190	0.00025	0.00079
28-Feb-13	0.106	0.00025	0.00079
31-Mar-13	0.160	0.000025	0.00079
30-Apr-13	0.240	0.00025	0.00079
31-May-13	0.250	0.00025	0.00079
30-Jun-13	0.230	0.01[a]	0.00079
31-Jul-13	0.096	0.007[a]	0.00079
31-Aug-13	0.130	0.00025	0.00079
30-Sep-13	0.140	0.00012	0.00079
31-Oct-13	0.075	0.00025	0.00079
30-Nov-13	0.077	0.0012[a]	0.00079
31-Dec-13	0.110	0.025[a]	0.00079

Source: *DMRLTOutput2013_v1.*

[a] Toxaphene concentration exceeds monthly average permit limit.

As part of the 2015 Annual Review, EPA contacted the SC DHEC to confirm the facility's 2013 toxaphene discharges. The state contact confirmed the discharges and stated that the higher concentrations for four months in 2013 were due to matrix interferences when analyzing the water samples (Rippy, 2015). The facility provided detailed notes discussing the issues on the monthly DMRs, shown in Table 3-114.

Table 3-114. Mohawk Industries 2013 DMR Notes for Toxaphene Discharges

Date	Facility DMR Notes
30-Jun-13	"The detection limit for toxaphene could not be achieved due to matrix interference caused by dyes. Two samples for June 2013 were analyzed attempting to achieve 0.5 micrograms per liter (µg/L). Both of the samples exhibited chromatographic co-elution, which is defined as multiple compounds having retention times that are the same or similar. Dilution was necessary to verify toxaphene was not present at the level reported, in which two co-eluting dye compounds were not present."
31-Jul-13	"Toxaphene is not used anywhere on the Oak River site, nor is it used in any process. There apparently is an interference in the testing leading to a false positive. The facility is currently changing to another lab certified in South Carolina that will also parallel test."
30-Nov-13	"Two samples were analyzed for toxaphene and the lowest detection limit achieved on both samples was 2.5 µg/L. A dilution was required for both samples to eliminate matrix interference from non-target background and resulted in an elevated reporting limit of 2.5 µg/L. The lab exhausted everything allowed in the EPA Method 8081B procedure and were unable to achieve a reading below our limit of 0.79 µg/L."
31-Dec-13	"PQL for toxaphene was found to be less than 0.025 mg/L using EPA Method 8081B. The sample was diluted due to matrix interferences that impaired the ability to make an accurate analytical determination. The detection limit was elevated in order to reflect the necessary dilution."

Source: Rippy, 2015

EPA reviewed 2014 toxaphene DMR discharges and confirmed the toxaphene TWPE has decreased to 3,860.

3.12.4 Textiles Sulfide Discharges in DMR

EPA's investigation of the sulfide discharges revealed that one facility, King America Finishing Inc., (King America) in Sylvania, GA, accounts for over 70 percent of the 2013 DMR sulfide discharges (shown in Table 3-115). EPA did not investigate the eight remaining facilities discharging sulfide as part of the 2015 Annual Review.

Table 3-115. Top 2013 DMR Sulfide Discharging Facilities

Facility Name	Facility Location	Pounds of Pollutant Discharged	Pollutant TWPE	Percent of Category TWPE
King America Finishing Inc.	Sylvania, GA	9,510	26,600	70.9%
All other sulfide dischargers in the Textiles Category[a]		3,910	10,900	29.1%
Total		**13,400**	**37,600**	**100%**

Source: *DMRLTOutput2013_v1.*
Note: Sums of individual values may not equal the total presented, due to rounding.
[a] Eight additional facilities submitted sulfide discharges in the 2013 DMR data.

King America in Sylvania, GA, produces cotton and poly/cotton woven fabrics. The facility discharges sulfide from outfall 001. The facility was issued a new permit in December 2013. The previous permit included a monthly average sulfide limit of 31 pounds per day (lb/day) (14.1 kilograms per day (kg/day)) and a daily maximum sulfide limit of 62 lb/day (28.1 kg/day) for outfall 001 (Beranek, 2015). The new permit includes a monthly average sulfide limit of 24 lb/day (10.9 kg/day) and a daily maximum sulfide limit of 48 lb/day (21.8 kg/day) for outfall 001 (GA EPD, 2013).

Table 3-116 presents King America's 2013 sulfide discharges, along with average monthly flow for outfall 001. As shown in Table 3-116, 2013 sulfide discharges are below the facility's previous and new permit limits.

Table 3-116. King America's 2013 DMR Monthly Sulfide Discharges Reported for Outfall 001

Date	Monthly Average Flow (MGD)	Monthly Average Quantity (kg/day)	NPDES Monthly Average Permit Limit (kg/day)[a]
31-Jan-13	1.28	5.44	14.1
28-Feb-13	1.38	5.89	14.1
31-Mar-13	1.40	5.45	14.1
30-Apr-13	1.41	5.89	14.1
31-May-13	1.20	4.98	14.1
30-Jun-13	1.48	5.60	14.1

Table 3-116. King America's 2013 DMR Monthly Sulfide Discharges Reported for Outfall 001

Date	Monthly Average Flow (MGD)	Monthly Average Quantity (kg/day)	NPDES Monthly Average Permit Limit (kg/day)[a]
31-Jul-13	1.61	7.44	14.1
31-Aug-13	1.72	6.50	14.1
30-Sep-13	1.73	6.59	14.1
31-Oct-13	1.57	6.08	14.1
30-Nov-13	1.59	6.84	14.1
31-Dec-13	1.44	5.65	10.9

Source: *DMRLTOutput2013_v1*; Beranek, 2015, GA EPD, 2013.

[a] The permit limit listed for January to November 2013 is from the facility's previous permit, which expired in November 2013. The permit limit listed for December 2013 is from the facility's new permit, issued in December 2013.

As part of the 2015 Annual Review, EPA contacted the facility to discuss their sulfide discharges. The facility contact confirmed the 2013 discharges and stated that the facility monitors for sulfide on a daily basis. The majority of the daily samples are non-detect and the facility uses the detection limit for these samples to calculate monthly average loads. Because the monthly average values submitted on the DMR are averages of the daily samples collected throughout the month and non-detect samples are assumed to be at the detection limit, the overall monthly average load is always equivalent to or greater than the detection limit for sulfide (Hutcheson, 2015). Sulfide discharges are below permit limits for outfall 001 and the facility is performing daily monitoring; therefore.

3.12.5 Textiles Category Findings

The estimated toxicity of the Textiles Category discharges resulted primarily from toxaphene and sulfide discharges reported on DMRs. From the 2015 Annual Review, EPA found:

- ***Toxaphene.*** One facility, Mohawk Industries, Inc. Oak River Facility, in Bennettsville, SC, contributed 100 percent of the 2013 DMR toxaphene discharges. The facility experienced matrix interferences with analyzing samples in 2013, resulting in false positive results; therefore, EPA does not consider Mohawk Industries' reported toxaphene discharges to be representative of discharges across the Textiles Category.
- ***Sulfide.*** King America Finishing, Inc., in Sylvania, GA, contributed over 70 percent of the 2013 DMR sulfide discharges. All 2013 sulfide discharges are below the facility's permit limits and the facility is performing daily monitoring.

3.12.6 Textiles Category References

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2. ERG. 2015. Preliminary Category Review – Facility Data Review for Point Source Category 410 – Textiles. (September). EPA-HQ-OW-2015-0665. DCN 08204.

3. GA EPD. 2013. Georgia Department of Natural Resources, Environmental Protection Division. *NPDES Permit: King America Finishing, Inc. (GA0003280).* (November 19). EPA-HQ-OW-2015-0665. DCN 08205.

4. Hutcheson, Matthew. 2015. Telephone and Email Communication Between Matthew Hutcheson, King America Finishing, and Kimberly Bartell, Eastern Research Group, Inc., Re: 2013 DMR Sulfide Discharges. (May 13). EPA-HQ-OW-2015-0665. DCN 08206.

5. Rippy, Crystal. 2015. Telephone and Email Communication Between Crystal Rippy, South Carolina Department of Health and Environmental Compliance, and Kara Edquist, Eastern Research Group, Inc., Re: 2013 DMR Discharges for Mohawk Industries. (February 13). EPA-HQ-OW-2015-0665. DCN 08207.

6. U.S. EPA. 2005. *Preliminary 2005 Review of Prioritized Categories of Industrial Dischargers.* Washington, D.C. (August). EPA-821-B-05-004. EPA-HQ-OW-2004-0032-0016.

7. U.S. EPA. 2006. *Technical Support Document for the 2006 Effluent Guidelines Program Plan.* Washington, D.C. (December). EPA-821-R-06-018. EPA-HQ-OW-2004-0032-2782.

8. U.S. EPA. 2007. *Technical Support Document for the Preliminary 2008 Effluent Guidelines Program Plan.* Washington, D.C. (October). EPA-821-R-07-007. EPA-HQ-OW-2006-0771-0819.

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10. U.S. EPA. 2012. *The 2011 Annual Effluent Guidelines Review Report.* Washington, D.C. (December). EPA 821-R-12-001. EPA-HQ-OW-2010-0824-0195.

11. U.S. EPA. 2014. *The 2013 Annual Effluent Guidelines Review Report.* Washington, D.C. (September). EPA-821-R-14-003. EPA-HQ-OW-2014-0170-0077.

12. U.S. EPA. 2016. *Preliminary 2016 Effluent Guidelines Program Plan.* Washington, D.C. (June). EPA-821-R-16-001. EPA-HQ-OW-2015-0665. DCN 08208.

4. EPA'S 2015 REVIEW OF ADDITIONAL INDUSTRIAL CATEGORIES AND POLLUTANTS

For the 2015 Annual Review EPA also initiated a review of two additional point source categories that were not identified as categories warranting further review in the 2015 TRA; Battery Manufacturing (40 CFR Part 461) and Electrical and Electronic Components (40 CFR Part 469), specifically Subpart B Electronic Crystals. In addition, EPA reviewed in more detail 2-Mercaptobenothiazole (MBT), a chemical compound used in tire manufacturing. Tire manufacturing is covered under the Rubber Manufacturing Point Source Category (40 CFR Part 428), Subpart A (Tire and Inner Tube Plants Subcategory).

EPA initiated these reviews to address comments received from stakeholders regarding recent changes to these industries as well as potential new pollutant releases to the environment through industrial wastewater discharge. As part of these reviews, EPA reviewed the existing ELGs and supporting development documents, examined recent changes to the industries, including new processes and technologies that may be generating new pollutants of concern, or sources of industrial wastewater discharge not previously considered, and reviewed readily available data on current discharges.

EPA documented the quality of the data supporting its review of these industrial categories, analyzed how the data could be used to characterize the industrial wastewater discharges, and prioritized the findings for further review. See Appendix A of this report for more information on data usability and quality of the data sources supporting these reviews.

Sections 4.1, 4.2, and 4.3 of this report provide details of each of these reviews.

4.1 Battery Manufacturing (40 CFR Part 461)

Stakeholders raised concerns about potential wastewater discharges from new battery technologies, notably in comments submitted in response to EPA's *Final 2010 Effluent Guidelines Program Plan* (76 FR 66286; U.S. EPA, 2013). Concerns centered on the recent advent of vanadium redox batteries, as well as the increased production of lithium ion batteries (including electric vehicle batteries). As part of the 2015 Annual Review, EPA performed the following research to evaluate whether further review of the Battery Manufacturing Category is warranted:

- Reviewed the Battery Manufacturing Point Source Category Effluent Limitations Guidelines and Standards (ELGs).
- Collected information about the current status of U.S. battery manufacturing.
- Evaluated the applicability of the existing ELGs to more recent production practices, reviewed readily available information on wastewater generated from these more recent production practices.

The Battery Manufacturing ELGs (40 CFR Part 461) were promulgated in 1984. The ELGs set limits for subcategories based on the anode material: cadmium, calcium, lead, leclanché,[44] lithium, magnesium, and zinc. EPA's review indicates that battery technologies have

[44] Leclanché is a type of zinc anode battery containing acid chloride electrolytes.

greatly advanced since the promulgation of the Battery Manufacturing ELGs and that wastewater discharges from the manufacture of some of the new battery technologies may not be covered. However, EPA identified little information on the manufacturing processes for these battery technologies and how they might generate wastewater. In addition, EPA identified only limited information about the extent of U.S. manufacturing of batteries that use advanced and emerging battery technologies.

The following sections provide an overview of the Battery Manufacturing ELGs applicable to current U.S. battery manufacturing, specifically consideration of two new battery technologies: vanadium redox batteries and lithium ion batteries (including electric vehicle batteries).

4.1.1 Overview of Battery Manufacturing, the ELGs, and Current U.S. Manufacturing

Battery manufacturing encompasses the production of modular electric power sources that contain part or all of their fuel within the unit and that generate electric power directly by a chemical reaction (U.S. EPA, 1984a). There are three major components of a battery cell (see Figure 4-1):

- Anode (negative electrode)
- Cathode (positive electrode)
- Electrolyte

The electrolyte separates the anode from the cathode and causes a chemical reaction that generates electrons at the anode, resulting in an electrical difference between the anode and cathode. When the electrical circuit is closed, such as when connecting the battery to a light bulb, electrons flow from the anode to the cathode and the battery discharges (indicated by arrows in Figure 4-1). Rechargeable batteries may be repeatedly discharged and recharged. During charging, electrons flow in reverse, from the cathode to the anode, to restore the battery to its original state (Northwestern University, 2014).

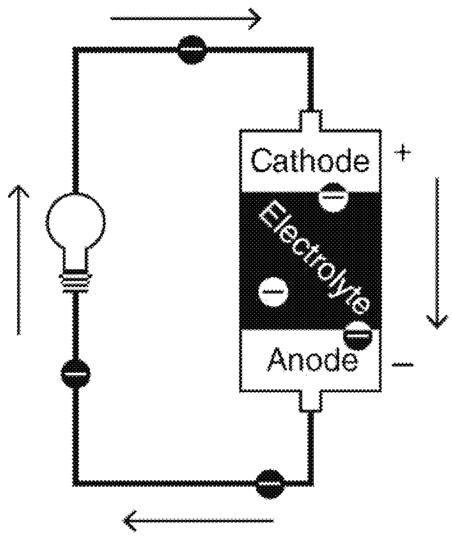

Figure 4-1. Simplified Battery Diagram (adapted from Northwestern University, 2014).

The Battery Manufacturing ELGs (40 CFR Part 461) are subcategorized by anode material. At the time of the rulemaking, data showed that battery cells with common process operations frequently use the same anode material, and that facilities manufacturing batteries with a common anode material generated wastewater bearing the same major pollutants (U.S. EPA, 1984a). The ELGs include seven subcategories: cadmium, calcium, lead, leclanché, lithium, magnesium, and zinc. Limitations are production normalized by the weight of the anode material, cathode material, or the entire battery cell, depending on the subcategory and wastewater stream.

In the mid-1980s, after the Battery Manufacturing ELGs were promulgated, rechargeable batteries, including lithium ion batteries, emerged in the market (Salkind et al., 2003). Current rechargeable battery types and their common uses are listed in Table 4-1. The existing ELGs do not cover wastewater discharges from the manufacture of some types of rechargeable batteries (e.g., nickel metal hydride) because the anode materials are not accounted for under any of the specific subcategories. In addition, rechargeable batteries are generally classified by the ions flowing between the anode and cathode, so different anode materials may be used for the same kind of battery, which would change the applicability of the ELGs even within the same rechargeable battery type. Two kinds of rechargeable batteries, lithium ion and vanadium redox, were recently brought to EPA's attention by stakeholders, and are further discussed below, in Section 4.1.2.

Table 4-1. Current Rechargeable Batteries and Common Uses

Rechargeable Battery Technology	Common Uses
Lithium Ion	Consumer electronic devices, portable electronics, electric and hybrid vehicles
Lithium Manganese Oxide	Consumer electronic devices
Nickel-Metal Hydride (NiMH)	Electric and hybrid vehicles
Nickel-Hydrogen (NiH_2)	Satellites and spacecraft
Vanadium Redox (Flow)	Energy storage (electric grid and remote communities)

Table 4-1. Current Rechargeable Batteries and Common Uses

Rechargeable Battery Technology	Common Uses
Nickel-Cadmium (NiCd)	Largely phased out and replaced by NiMH and other technologies

Sources: American Vanadium, 2014; Clyde Space, 2014; Energizer, 2010; Maxell, 2012; Vacuum Products Canada, Inc., 2013.

In 1984, as part of the development of the Battery Manufacturing ELGs, EPA collected information from 254 U.S. battery manufacturing facilities. At the time, 21 facilities reported having direct discharges to surface waters, 149 reported discharges to POTWs, and 84 reported zero discharges (U.S. EPA, 1984a, 1984b). From its 2015 Annual Review, EPA identified 25 active NPDES permits for battery manufacturing facilities in EPA's Integrated Compliance Information System – National Pollutant Discharge Elimination System (ICIS-NPDES)[45] database, but only one battery manufacturing facility reported DMR discharges greater than zero in 2013 (*DMRLTOutput2013_v1*). Fifty-eight facilities reported water releases greater than zero to TRI in 2013, 23 of which reported direct releases (*TRILTOutput2013_v1*). Current discharge data continue to suggest that a substantial portion of battery manufacturers discharge wastewater to POTWs. The data also suggest that there are more facilities reporting releases from battery manufacturing, as indicated in TRI, than are currently reporting discharges on DMRs. It should be noted, however, that the DMR and TRI data sets may not include information about all battery manufacturing facilities due to limitations of the reporting requirements. For example, some facilities classified as minor dischargers may not be captured in the DMR data. Additionally, TRI does not include data from small establishments that do not meet reporting thresholds. Further, the reported releases in TRI may be an overestimate, as TRI reporting requirements allow facilities to base release reports on estimates, not actual measurements. For more information on the limitations of the DMR and TRI datasets, see Section 2.1.

4.1.2 Overview of Rechargeable Batteries

Commercial and consumer uses of rechargeable batteries became widespread in the mid-1980s, after the Battery Manufacturing ELGs were promulgated. Further, with advances in hybrid and electric vehicles, the automobile industry increasingly uses rechargeable batteries. The following subsections provide a summary of the comments EPA received regarding vanadium redox, lithium ion, and other electric and hybrid vehicle batteries, in particular, as well as the information EPA has collected to date about rechargeable batteries.

Vanadium Redox Batteries

At a National Association of Clean Water Agencies (NACWA) National Pretreatment and Pollution Prevention Workshop in 2014, attendees raised concerns about the potential growth in manufacturing of vanadium redox batteries and the implications for wastewater management. The discussion indicated that vanadium redox batteries are currently fabricated in research and development laboratories and that all wastewater resulting from their production is hauled off site as hazardous waste. There was further speculation that, as production of vanadium redox batteries becomes more widely commercialized and the volume of wastewater generated

[45] Queried from EPA's Enforcement and Compliance History Online (ECHO) Water Facility search.

increases, these facilities may begin sending wastewater to POTWs or applying for discharge permits, as hauling and treating larger volumes of wastewater off site becomes too expensive.

Vanadium redox or vanadium flow batteries are being developed to function as sources of energy during power outages and for use in remote areas and developing countries. These batteries are rechargeable and generate electricity by pumping liquid electrolytes containing vanadium ions through electrochemical cells separated by ion selective membranes (Figure 4-2) (Salkind et al., 2003). Unlike traditional batteries, flow batteries are not closed systems. This allows for potential replacement of depleted electrolyte and may result in a reduced rate of degradation of the anode and cathode materials (St. John, 2014). Flow batteries contain a liquid electrolyte; therefore, handling may be a concern for disposal or waste management.

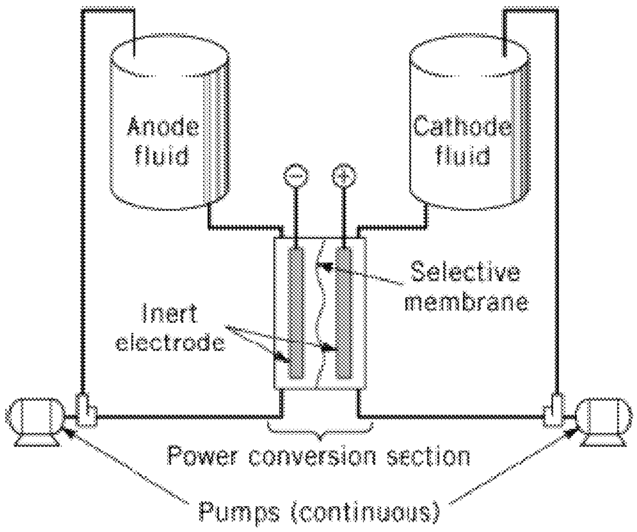

Figure 4-2. Simplified Schematic of a Redox Flow Battery (Salkind et al., 2003)

Because of the anode material they employ (often graphite), vanadium redox batteries may not be covered under the current Battery Manufacturing ELGs (40 CFR Part 461). However, EPA's investigation did not identify information that vanadium redox batteries are commercially manufactured in the U.S., nor did EPA find information about vanadium redox battery manufacturing processes. Available information suggests that vanadium redox battery manufacturing in the U.S. remains limited to the research and development phase at this time, which is consistent with the stakeholder comments (American Vanadium, 2014).

EPA identified one company in Canada, American Vanadium, which distributes German-made vanadium redox batteries in North America for electric grid energy storage. EPA searched the 2012 and 2013 Canadian National Pollutant Release Inventory (NPRI), Canada's legislated, publicly accessible inventory of pollutant releases to air, water and land, and reviewed disposals and transfers for recycling by the company name and by industry. EPA did not find any reported wastewater releases in the Canadian NPRI (Environment Canada, 2014). American Vanadium has an operations center in Nevada; however, searches of the DMR Pollutant Loading Tool by company name and location did not indicate that the facility had a NPDES permit or reported to TRI.

Lithium Ion Batteries

The Association of Clean Water Administrators (ACWA) commented on EPA's Final 2010 Effluent Guidelines Program Plan, recommending that EPA modify the battery manufacturing category to explicitly exclude lithium ion batteries from the lithium battery subpart (U.S. EPA, 2013). No further detail was provided in the comment.

Lithium ion batteries are a type of rechargeable battery in which the lithium ions move from the anode to the cathode during discharge and from the cathode to the anode during recharge. Lithium ion battery technologies are rapidly advancing, and there are many battery types and configurations using a variety of materials for the anode, cathode, and electrolyte. In these batteries, lithium is often part of the electrolyte, which can be a solid or liquid medium (Salkind et al., 2003), and is not necessarily the anode material. Graphite or hard carbon is often used as the anode material, but lithium and lithium alloys are also used. Lithium ion batteries using silicon as the anode material are also being developed (Patterson, 2009).

The Lithium Subcategory (Subpart E) of the Battery Manufacturing ELGs sets limits for wastewater pollutants in lithium anode battery manufacturing discharges (40 CFR Part 461.50). The battery cells reported to be manufactured at the time of the rulemaking did not use an aqueous or liquid electrolyte. EPA noted in the 1984 *Development Document for Effluent Limitations Guidelines and Standards for the Battery Manufacturing Point Source Category* that there are few process wastewater sources associated with lithium anode battery manufacturing (U.S. EPA, 1984a).

Subpart E includes standards for new sources (New Source Performance Standards and Pretreatment Standards for New Sources) covering four operations: lead iodide cathodes, iron disulfide cathodes, miscellaneous wastewater streams, and air scrubbers. Miscellaneous wastewater stream sources include ancillary operations, such as cell testing, scrap disposal, cell washing, and floor and equipment washing (U.S. EPA, 1984a). The standards explicitly prohibit discharges of wastewater pollutants from any battery manufacturing operations not listed.

Based on the applicability of Subpart E, wastewater discharges from manufacturing of lithium ion batteries using lithium as the anode material are subject to the limits for miscellaneous wastewater streams. This subpart, however, does not cover manufacturing of lithium ion batteries using a non-lithium anode material.

EPA identified one U.S. manufacturer of lithium ion batteries, EnerDel, Inc. (Indianapolis, IN).[46] The company does not hold NPDES permits for any of its facilities. EPA did not find further information about the extent of current U.S. lithium ion battery manufacturing or the waste streams generated during manufacture.

In April 2015, Tesla Motors announced it would begin production of the Powerwall, a rechargeable lithium-ion battery designed to store energy at individual residences for load shifting, backup power, and self-consumption of solar power generation, for delivery beginning in the late summer of 2015 (Tesla Motors, 2015a). EPA was not able to identify the anode type, based on available information. The battery is available in 7kWh and 10kWh capacities. Initial,

[46] ECHO Facility Search by facility name.

small-scale production will occur at Tesla's Fremont, CA factory, and in 2016, production will move to Tesla's factory in Nevada, which is currently under construction (Bomey, 2015). Tesla does not hold a NPDES permit for its Fremont, CA facility.

Electric Vehicle Battery Manufacturing

EPA received a public comment on its Final 2010 Effluent Guidelines Program Plan expressing concern about potential environmental effects if electric vehicle battery manufacturing facilities were to be built in California (U.S. EPA, 2013).

Table 4-2 below summarizes the types of batteries used in several hybrid and electric vehicle models; however, none of these batteries are currently manufactured in the U.S. Lithium ion battery technology is used in a majority of the current electric and hybrid vehicles in the U.S. market.

Table 4-2. Rechargeable Battery Types used in Hybrid and Electric Vehicles

Car Company	Model	Electric Battery
Chevrolet	Volt Electric Vehicle	Lithium Ion
	Spark Electric Vehicle	Lithium Ion
Honda	Fit Electric Vehicle	Lithium Ion
	Accord Hybrid	Lithium Ion
	Insight Hybrid	Nickel-Metal Hydride
	Civic Hybrid 2011 – 2015	Lithium Ion
	Civic Hybrid 2001 – 2010	Nickel-Metal Hydride
	CR-Z Hybrid	Lithium Ion
	FCX Clarity Fuel Cell Electric Vehicle	Lithium Ion
Tesla	S Electric Vehicle	Lithium Ion
Toyota	Prius Hybrids	Nickel-Metal Hydride
	Prius Plug-In Hybrid	Lithium Ion
	Camry Hybrid	Nickel-Metal Hydride
	Avalon Hybrid	Nickel-Metal Hydride
	Highlander Hybrid	Nickel-Metal Hydride
Scion	iQ Electric Vehicle	Lithium Ion

Sources: General Motors, 2014a, 2014b; American Honda Motor Company, Inc., 2013a, 2013b, 2014, 2015a, 2015b, 2015c, 2015d; Tesla Motors, 2015c; Toyota, 2012, 2015a, 2015b, 2015c, 2015d, 2015e, 2015f, 2015g.

Tesla Motors currently purchases lithium ion batteries for its electric vehicles from Panasonic. Tesla and Panasonic began building a large-scale battery manufacturing facility in Nevada in 2014. The plant is expected to be completed in 2017 and is planned to produce 35 GWh of cells and 50 GWh of packs per year by 2020, an amount which would exceed all of the current lithium ion battery production worldwide (Ramsey, 2014; Tesla Motors, 2015b).

4.1.3 Summary of Findings from EPA's Review of Battery Manufacturing

EPA's research indicates that battery technologies have greatly changed since the promulgation of the Battery Manufacturing ELGs in 1984, with the advent of rechargeable batteries, including lithium ion and vanadium redox batteries. The 1984 ELGs apply to discharges from battery manufacturing facilities if the battery type they manufacture is listed as one of six manufacturing subcategories. Each subcategory is based on the type of metal used to manufacture the battery anodes. It is unclear at this time whether the existing ELGs cover discharges from the manufacture of newer types of batteries because the anode materials are not covered by any of the specific ELG subcategories. In addition, rechargeable batteries are generally classified by the ions flowing between the anode and cathode, so different anode materials may be used for the same kind of battery and whether the current ELGs address discharges for this type of manufacturing is also questionable.

However, despite the advances in technologies, battery manufacturing in the U.S. appears to have declined since the 1980s. EPA identified 58 battery manufacturing facilities that reported water releases greater than zero to TRI in 2013, 23 of which reported direct releases (*TRILTOutput2013_v1*). EPA identified 25 NPDES permits for battery manufacturing facilities currently designated as active (ICIS-NPDES), but only one battery manufacturing facility reporting DMR discharges greater than zero in 2013 (*DMRLTOutput2013_v1*).

EPA identified at least one facility, a Tesla Motors plant being built in Nevada, which will be manufacturing lithium ion batteries on a large scale. In addition, stakeholders have expressed concern over potential growth in manufacturing of vanadium redox and electric vehicle batteries and its implications for wastewater management.

While the battery manufacturing industry and battery technologies are advancing, EPA has not yet identified information regarding the generation of new wastewater discharges from the manufacture of these new battery technologies. However, stakeholders expressed concerns about a resurgence of battery manufacturing in the U.S., particularly related to vanadium redox and electric vehicle batteries. EPA has found it does not fully understand the state of the battery manufacturing industry, new battery technologies, the applicability of the existing ELGs, and the potential for new pollutants in the industry's wastewater discharges. Specifically, EPA's data gaps include:

- Potential future growth of the industry as reliance on electrical storage systems grows.
- What production processes during the manufacture of lithium ion, vanadium redox, and electric vehicle batteries generate wastewater.
- How the wastewater is managed.
- What pollutants are present in any discharges of industrial wastewater.
- Whether current U.S. battery manufacturers have changed, or plan to change, the types of batteries they produce.
- Whether there are other new battery manufacturing facilities being built in the U.S. and the types of batteries they will be producing.

4.1.4 References for Battery Manufacturing

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4.2 Electrical and Electronic Components (40 CFR Part 469)

At a National Association of Clean Water Agencies (NACWA) National Pretreatment and Pollution Prevention Workshop in 2014, stakeholders raised concerns regarding the applicability of the Electrical and Electronic Components Effluent Limitations Guidelines and Standards (E&EC ELGs) (40 CFR Part 469) to the manufacture of sapphire crystals. Sapphire crystals are used in an increasing number of electronic devices. Further, stakeholders expressed concern related to new pollutants of concern, specifically the use of nanomaterials in the manufacturing of electronics that EPA did not consider during the development of the E&EC ELGs. As a result, as part of the 2015 Annual Review, EPA began reviewing the E&EC ELGs, primarily as they relate to sapphire crystal manufacturing, to determine whether recent changes within the E&EC industry are resulting in new wastewater discharges or pollutants of concern.

4.2.1 Overview of the Electrical and Electronic Components ELGs in Relation to Sapphire Crystal Manufacturing

In 1983, EPA promulgated the E&EC ELGs, which regulate pollutant discharges from four subcategories: semiconductors, electronic crystals, cathode ray tubes, and luminescent materials. Subpart B specifically covers discharges resulting from the manufacture of electronic crystals. Subpart B defines electronic crystals as *"crystals or crystalline material which because of their unique structural and electronic properties are used in electronic devices. Examples of these crystals are crystals comprised of quartz, ceramic, silicon, gallium arsenide, and idium arsenide."* In addition, manufacture of electronic crystals is defined in this subpart as *"the growing of crystals and/or the production of crystal wafers for use in the manufacture of electronic devices."* While the definition of electronic crystals does not specifically mention sapphire crystals, sapphire crystals that are grown and made into wafers are used in the manufacture of electronic devices and thus meet the definition of electronic crystals. Therefore, 40 CFR Part 469 Subpart B is applicable to wastewater discharges generated from growing sapphire crystals and producing sapphire crystal wafers. Subpart B includes concentration-based effluent limitations for total toxic organics (TTO), arsenic, fluoride, total suspended solids (TSS), and pH for both new and existing direct and indirect dischargers.

In developing the ELGs, EPA identified four main types of electronic crystals: piezoelectric crystals (primarily quartz), lithium niobate, liquid crystals, and semiconducting crystals (primarily silicon, gallium arsenide, and gallium phosphate) (U.S. EPA, 1983). At the time, EPA identified only one sapphire crystal manufacturing facility.

4.2.2 Overview of Sapphire Crystals Manufacturing and Wastewater Generation

Sapphire, the common name of the mineral corundum, is an aluminum oxide (α-Al_2O_3) gemstone that is widely used in industrial applications due to its physical properties (Dinh, 2011). After diamonds and silicon carbide, sapphire is one of the hardest materials; it is chemically inert and transmits light effectively (PR Hoffman, 2013). These properties make sapphire crystals a commonly used substrate in light-emitting diodes (LEDs) and in solar cells, hard drives, lasers, and other optical applications.

Sapphire Crystal Growth

While sapphire crystals have been produced for over a century (Harris, 2004), they were not widely used for electronics until the mid-1980s, when industry began using them as substrates in silicon-on-sapphire microprocessors (Peregrine Semiconductor Corporation, 2012). Due to the increased demand for sapphire crystals for smartphones, LEDs, and other electronic devices and components, sapphire crystal manufacturing has grown dramatically in recent years (Wray, 2011). The industry manufactures synthetic sapphire crystals for industrial applications by a variety of methods, depending on the end product desired. While methods vary, they all begin with molten aluminum oxide (Al_2O_3) that is formed into a large synthetic sapphire crystal, called a boule (ClearlySapphire.com, 2014).

The generally recognized methods of sapphire crystal formation are described below. All of the methods are commonly used for sapphire crystal production, except the Edge-Defined Film-Fed Growth (EFG) method, which does not produce crystals of high optical quality. The sapphire crystal growth processes do not generate wastewater; however, they may produce non-contact cooling water.

- *Czochralski Method.* In the Czochralski method, aluminum oxide is melted in a crucible and a sapphire seed crystal is dipped into it, rotated, and pulled out of the melt, promoting crystal growth (Harris, 2004). The growth process takes weeks, and the resulting crystal is used in lasers, transparent electronics, high temperature process windows, and optical applications (ClearlySapphire.com, 2014).
- *EFG Method.* In the EFG method, after aluminum oxide is melted in a crucible it moves up a molybdenum die, used to shape the crystal, at the bottom of the crucible by capillary attraction. A seed crystal is dipped into the melt on top of the die and the seed is pulled out, promoting crystal formation (Harris, 2004). The crystals created using this method are typically used in applications that do not require high quality crystals. (ClearlySapphire.com, 2014).
- *Gradient Solidification.* In gradient solidification, a hemispheric crucible with a sapphire seed in the bottom is filled with alumina. A temperature gradient is created in a vacuum and the seed crystal is partially melted. The slow cooling of the alumina promotes sapphire crystallization (Harris, 2004).
- *Heat Exchanger Method.* The heat exchanger method begins with a sapphire seed crystal placed in a crucible. The crucible is then filled with pure alumina crackle. The crackle is melted, while partially melting the seed crystal. The seed is cooled slowly and the resulting crystal is of high quality (ClearlySapphire.com, 2014; Harris, 2004).
- *Kyropoulos Method.* The Kyropoulos method begins with melting high-purity aluminum oxide powder in a crucible. A seed crystal forms at the bottom and is drawn out under a highly controlled thermal gradient. The resulting boules are highly pure and can be used for electronics and optics (ClearlySapphire.com, 2014).
- *Verneuil Flame-fusion Crystal Growth Method.* The Verneuil method, developed in 1902, was the first method developed for industrial sapphire production. It uses powdered aluminum oxide (Al_2O_3) and chromium oxide (Cr_2O_3). The powders are nearly melted and dropped onto an alumina pedestal. The seed crystal that forms is

removed from the melt and rotated (Harris, 2004). The resulting crystals have internal striations, so they have limited use (ClearlySapphire.com, 2014).

Sapphire Crystal Wafer Production

Production of sapphire crystal wafers for electronic applications begins with a sapphire boule that can be over one hundred kilograms. The boule is sliced into wafers at a defined angle that depends on the end-use. The wafers are then lapped, ground, polished, and cleaned with a wet chemical cleaner (PR Hoffman, 2013). These polished wafers are used for electronic displays, semiconductors, LEDs, and lenses whose performance can be altered by surface features (Dinh, 2011).

The processes used in the manufacture of sapphire crystal wafers are generally the same as in the manufacture of silicon crystal wafers, from the formation of a crystalline boule, to the slicing, lapping, grinding, polishing, and cleaning. Figure 4-3 outlines the silicon wafer production process. As indicated in the diagram, several of the wafer production processes can generate wastewater in the form of slurries and acids. Because silicon is not as hard as sapphire, the chemicals and slurries used in these processes may be different. However, the chemicals used in the preparation of sapphire wafers have not been studied as thoroughly as silicon wafers, so available information is limited (Kirby, 2008).

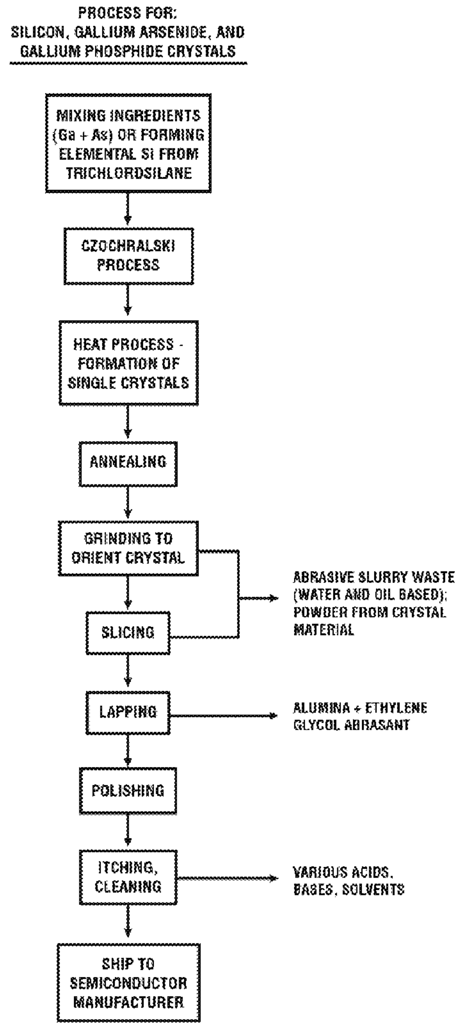

Figure 4-3. Basic Manufacturing Processes for Electronic Crystals (U.S. EPA, 1983)

Lapping, grinding, and polishing of sapphire crystals often require liquid media and an abrasive (Ng and Dumm, 2012). Wafer *lapping* typically uses an abrasive liquid slurry mixture with lapping plates to grind off any irregularities left after slicing, and results in a smooth, unpolished surface (Dinh, 2011). Wafer *grinding* may also use liquid slurries, but is more typically used for the coarse removal of material. Slurries used in these methods can be oil- or water-based and could result in wastewater production.

Sapphire wafer *polishing* involves any of several processes, including: mechanical polishing, wet chemical-mechanical polishing, dry chemical-mechanical polishing, colloidal silica polishing, and contactless chemical mechanical polishing. Chemical mechanical polishing is frequently used on sapphire crystals and uses chemical slurries for corrosion and abrasives (often alumina) for mechanical friction (Zhang, et al., 2010; Dinh, 2011). Other slurries used for the final steps of sapphire crystal production include alpha-alumina-based, scale silica-based, polycrystalline diamond, nanodiamond, and colloidal silica slurries (Grish, 2011).

Sapphire *etching* commonly uses sulfuric and phosphoric acids (Kirby, 2008), and *patterning* of sapphire uses strong acids (Chang, et al., 2013).

Liquid-based slurries and chemicals used in the final processing of sapphire crystal wafers may result in chemical waste discharges. EPA reported that in the 1980s, semiconductor production used 166 million gallons of water per day, which is treated prior to discharge. Sapphire is now commonly used as a substrate for semiconductors, but the current state of wastewater discharges from sapphire crystal wafer production is not clear. More recent data indicate that chemical and mechanical processing of electronic wafers in general (i.e., not just sapphire wafers) can produce six liters of slurry waste per individual wafer (Belongia, 1999).

Sapphire Crystal Manufacturing in the U.S.

EPA identified several companies that manufacture, process, and finish sapphire crystals in the U.S. These companies include Saint-Gobain Crystals, Rubicon Technology, and GT Advanced Technologies (GTAT, 2013; Saint-Gobain, 2009; Sterling, 2011).[47]

4.2.3 Summary of Findings from EPA's Review of the Electrical and Electronic Components ELGs in Relation to Sapphire Crystal Manufacturing

Sapphire crystals are used in an increasing number of electronic devices, and stakeholders have recently raised concerns regarding the applicability of E&EC ELGs and new pollutants discharged from sapphire crystal manufacturing. EPA's review of the E&EC ELGs determined that Subpart B - Electronic Crystals covers wastewater discharges generated from growing sapphire crystals and producing sapphire crystal wafers. While the ELGs do not specify sapphire crystals, they are a crystal or crystalline material used in the manufacture of electronic devices because of their unique structural and electronic properties, and therefore meet the applicability of that Subpart.

- Preliminary research indicates that sapphire crystal wafer production usually generates wastewater in the form of slurries and acids. The chemicals used in the preparation of sapphire wafers have not been thoroughly studied, so available information is limited. As a result, EPA has not yet determined the pollutants of concern or current wastewater management practices. Further, public comments expressed concern about pollutants that EPA did not consider during the development of the existing E&EC ELGs, specifically, nanomaterials. EPA confirmed that nanodiamonds are used in sapphire crystal polishing slurries. In addition, EPA identified a number of facilities in the U.S. that are likely manufacturing sapphire crystals and wafers. To date, EPA's review has not definitively determined whether the manufacture of sapphire crystals and wafers results in the discharge of pollutants not covered by 40 CFR Part 469. EPA has found it does not fully understand the state of the E&EC industry in the U.S., including advances in technology and manufacturing processes, and potential new pollutants of concern present in wastewater discharge. Specifically, EPA's data gaps include: What additional pollutants of concern may be present in discharges from sapphire crystal manufacturing that are not regulated by the existing ELGs.

[47] This list is not exhaustive; it includes facilities that were easily identified through internet research.

- How permitting authorities are currently addressing discharges from facilities that manufacture sapphire crystals.
- What manufacturing processes generate wastewater, and how the wastewater is treated, reused, and/or discharged.
- How many facilities in the U.S. are manufacturing sapphire crystals and what is the volume of production.

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4.3 2-Mercaptobenzothiazole (MBT)

EPA received a public comment on its *Preliminary 2012 Effluent Guidelines Program Plan* from the Association of Clean Water Administrators (ACWA) concerning the environmental release of 2-mercaptobenzothiazole (MBT). The comment cited research indicating that the chemical is highly toxic to aquatic life, slow to biodegrade, and, because it is released as tires wear, is pervasive in the environment. The comment expressed concern that this chemical is not codified in 40 CFR Part 401.15[48] as a toxic pollutant. The commenter also asserts that the chemical is not captured by the TRI database, although EPA notes that this is not accurate (U.S. EPA, 2014).[49]

In its response to the comment, EPA noted that the effluent guidelines program under the Clean Water Act focuses on the discharge of pollutants from industrial wastewater sources, and that it is not necessarily the best program for addressing the environmental release of MBT from automobile tires wearing down from use on roads. Other efforts, such as pollution prevention and product substitution, under statutes such as the Toxic Substances Control Act (TSCA), may be more appropriate to address the potential issues associated with MBT (U.S. EPA, 2014). However, as a direct follow-up to the comment, EPA looked into this chemical as part of the 2015 Annual Review, focusing specifically on its use in tire manufacturing, and any associated potential discharges. MBT is used in other industries, such as sodium and zinc salts of MBT, which are active ingredients in fungicides, microbiocides, and bacteriostats (U.S. EPA, 1994). However, these uses were outside of the scope of this review.

4.3.1 Overview of Existing ELGs Related to MBT and Rubber Manufacturing

The Rubber Manufacturing ELGs (40 CFR Part 428), specifically Subpart A, Tire and Inner Tube Plants, cover discharges from tire manufacturing. This subpart includes discharge limitations for TSS, oil and grease, and pH, but does not include limitations on toxic pollutants. EPA promulgated the Rubber Manufacturing ELGs in 1974 and has not significantly updated them since 1975.

4.3.2 Overview of MBT

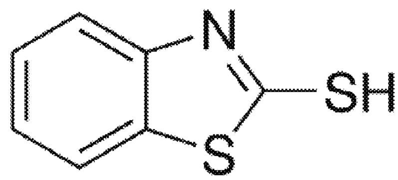
The following subsections discuss MBT's chemical properties, use, and environmental release.

MBT Properties

MBT is a beige or light yellow powder that is insoluble in water. Table 4-3 below presents MBT's properties.

[48] Provides a list of toxic pollutants designated pursuant to section 307(a)(1) of the Clean Water Act. Part 401 provides general provisions, such as definitions and test procedures that apply to additional regulations that implement the Clean Water Act.
[49] EPA notes that MBT was added to the TRI list of chemicals in 1995 (U.S. EPA, 2015).

Table 4-3. Properties of MBT

Property	Data	Chemical Structure[b]
Molecular Formula	$C_7H_5NS_2$	
Molecular Weight	167.25	
Melting Point	177-181°C	
Density	1.42 g/cm^3	
Flash Point	243°C	
Water Solubility	<0.1 g/100 mL at 19°C 0.032 g/100 mL[a]	
CAS Database Reference	149-30-4	

Source: Chemical Book, 2014, unless otherwise specified.
[a] Source for alternative water solubility value: ChemicalLand21.com, 2015.
[b] Source: Sigma-Aldrich, 2015.

MBT's Use in Tires

Vulcanization is the process by which plastic rubber is converted into the elastic or hard rubber state. The process is brought about by the linking of macro-molecules at reactive sites (U.S. EPA, 1974). Vulcanization improves the mechanical properties of rubber (Rodgers, et al., 2004). In the early 1900s, researchers discovered accelerators that help control the vulcanization process and the number and type of sulfur crosslinks that form. Aniline was the first organic compound used to accelerate the reaction of sulfur with natural rubber. Since then, the industry has developed less toxic aniline derivatives that possess increased acceleration activity. MBT, one such compound, is prepared by heating aniline, carbon disulfide, and sulfur in an autoclave at elevated temperature and pressure. MBT is currently the highest volume organic accelerator used to manufacture rubber tires (Ohm, 2000). However, the use of accelerators in the U.S. has been declining due to longer-lasting tires and reduced number of U.S. manufacturers (Ohm, 2000).

MBT's Release to the Environment

An emission scenario, published by the Organization for Economic Co-operation and Development (OECD) in 2004, evaluated the sources, use patterns, and release pathways of rubber industry chemical additives to support estimates of environmental releases (OECD, 2004). OECD specifically examined scenarios for formulation and processing emissions to wastewater, formulation and processing emissions to air and soil, and the private use of rubber products by tire abrasion, including emission to surface water and soil. Tire abrasion was the only scenario that resulted in the release of MBT.

EPA's review of available discharge data identified five facilities that reported releases of MBT to TRI in 2013, as shown in Table 4-4 below. None of these facilities are tire manufacturers, though this data set may be limited, as only facilities that manufacture and process more than 25,000 pounds, or otherwise use more than 10,000 pounds of a listed chemical in a given year, report releases to TRI (see Section 2.1 of this report for a discussion of the limitations of TRI data). Further, each of the reported releases of MBT from other types of rubber manufacturing are less than five pounds per year.

EPA identified 12 tire manufacturers (by SIC Code 3011) in the U.S. reporting DMR discharges greater than zero in 2013 (*DMRLTOutput2013_v1*). None of these facilities reported discharges of MBT. However, MBT is not a regulated pollutant in the Rubber Manufacturing ELGs; therefore, facilities are unlikely to report MBT discharges unless their permit contains specific limitations or monitoring requirements.

Table 4-4. Facilities Reporting MBT Releases to TRI in 2013

Point Source Category	NAICS Code and Description	Facility Name and Location	Facility Description	Pounds MBT
Organic chemicals, plastics and synthetic fibers (OCPSF) (40 CFR Part 414)	325199 - All Other Basic Organic Chemical Manufacturing	Emerald Performance Materials LLC, Henry, IL	Produces and markets specialty chemicals for use in aerospace, food, beverages, cosmetics, toothpaste, household products, paint, tires, automobiles, and sports gear, etc. (Emerald Performance Materials, 2006)	5,480
	325998 - All Other Miscellaneous Chemical Product and Preparation Manufacturing	Dober Group, Hazelton, PA	Produces liquids for Dober Chemical's Cooling Systems Division and GreenFloc Division (Dober, 2015).	180
Rubber Manufacturing (40 CFR Part 428)	326299 - All Other Rubber Product Manufacturing	International Automotive Components, Canton, OH	Produces and supplies automotive interior components (IAC, 2015).	5
		Gold Key Processing Inc., Middlefield, OH	Develops and produces black and non-black rubber compounds (GoldKey, 2015).	2.6
	326291 - Rubber Product Manufacturing for Mechanical Use	Cooper Standard Automotive, Inc., Auburn, IN	Produces sealing and trim systems, fuel and brake delivery systems, and anti-vibration control products for the automotive industry (CooperStandard, 2015).	1

Source: *TRILTOutput2013_v1*
Note: Values are rounded to three significant figures.

4.3.3 Summary of Findings from EPA's Review of MBT

Though tire manufacturers use MBT as a vulcanization accelerator, EPA's review of 2013 DMR and TRI data did not identify any discharges of MBT from tire manufacturers, although there may be releases from other industries, including OCPSF and rubber manufacturing in general. In addition, concerns regarding MBT's release to the environment have centered on dust from the abrasion and wear of tires, which is not under the purview of the effluent guidelines program.

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Message

From: Flanders, Phillip [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=0CB247EF96F642F98CB727A9ED48E49E-FLANDERS, P]
Sent: 8/2/2018 8:18:24 PM
To: Parikh, Pooja [Parikh.Pooja@epa.gov]
Subject: OGC review of a briefing
Attachments: PrelimPlan14 Briefing_080218.docx

Pooja,

Could I ask you to review this version of the briefing for Options Selection for Preliminary Plan 14? Specifically, could you review the first four bullet points to make sure that I haven't misrepresented the Clean Water Act? The rest of the body of the briefing is a condensed version of the briefing we gave to Deborah Nagle that has been slightly rearranged, and the appendix is unchanged from when you last saw it.

Thank you,

Phillip Flanders, Ph.D., P.E.

Environmental Engineer
Engineering and Analysis Division
Office of Science and Technology
Office of Water

EPA United States Environmental Protection Agency

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Message

From: Flanders, Phillip [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=0CB247EF96F642F98CB727A9ED48E49E-FLANDERS, P]
Sent: 7/12/2018 8:00:50 PM
To: Milam, Karen [Milam.Karen@epa.gov]
Subject: Briefing for Deborah
Attachments: PrelimPlan14 Briefing_061818.docx

Attached

6/18/18

Preliminary Effluent Guidelines Program Plan 14 - Option Selection Briefing

Background on Effluent Guidelines Program Planning Process

- The Clean Water Act authorizes EPA to establish technology-based Effluent Limitations Guidelines and Standards (ELGs) to control discharges of pollutants in industrial wastewater to surface waters and publicly owned treatment plants (POTWs).
    - Statute designed to increasingly elevate the technology floor for all dischargers in an industrial sector to match the performance of the best plants in the industry.
- The CWA also directs EPA to review the existing effluent guidelines annually, and revise them if appropriate, as well as to identify new categories of sources for which ELGs have not been developed. The statute also requires annual review of existing pretreatment standards, and revision, if appropriate.
    - In reviewing (through studies) existing ELGs for possible revision, we typically consider four main factors:
        - The performance of applicable and demonstrated wastewater treatment technologies, process changes, and pollution prevention alternatives to reduce pollutants in an industrial category's wastewater;
        - The costs (economic achievability) of demonstrated wastewater treatment technologies, process changes, and pollution prevention alternatives;
        - The amount and types of pollutants in an industrial category's discharge; and
        - The opportunity to promote technological innovation to eliminate inefficiencies or impediments to pollution prevention.
    - In identifying new categories:
        - For discharges to surface waters, the CWA requires EPA to identify sources discharging non-trivial amounts of toxic and non-conventional pollutants to surface waters for which EPA has not established ELGs.
        - For discharges to POTWs, the CWA requires EPA to identify sources of pollutants which are determined not to be susceptible to treatment by such treatment works or which would interfere with the operation of such treatment works.
- The CWA directs EPA to publish a plan (the Effluent Guidelines Program Plan) every two years that establishes a schedule for the annual review and revision of existing effluent guidelines and identifies any new industries identified for ELG rulemaking. The plan must also provide a rulemaking schedule for any new industries identified, under which promulgation of guidelines shall be no later than 3 years after publication of the plan.
    - We typically prepare a Preliminary Plan one year, take public comment, and then publish a Final Plan the next.
    - We also provide information on our annual review of existing ELGs in the plans to increase transparency and stakeholder awareness of the planning process.

6/18/18

Status of the Planning Process

- We published the Final 2016 ELG Plan on May 2, 2018.
  - The Plan identified one new rulemaking (and the associated schedule) for the Steam Electric Power Generating Point Source Category.
  - The Plan announced that EPA is initiating three new studies:
    - Holistic study of oil and gas extraction wastewater from onshore facilities
    - Study of per- and polyfluoroalkyl substances (PFAS)
    - Electrical and Electronic Components (E&EC)
  - Also provided summary from our data review efforts, including updates on "detailed" studies for two industrial categories: petroleum refining and centralized waste treatment (CWT) facilities.
- **We are now seeking confirmation on the content of the next plan – Preliminary ELG Program Plan 14 (Preliminary Plan 14).**
- **We have changed the numbering system for the biennial plans**
  - Previous plans were named based on the year at the end of the biennial cycle. For example, the most recent final plan was the Final 2016 Plan and the next biennial plan would have been the Final 2018 Plan. However, we don't expect to publish the next Final Plan until April of 2020.
  - To reduce confusion, we will number each biennial plan instead. Since the Final 2016 ELG Program Plan was the 13th Final ELG Program Plan that we have produced, the next final plan is Final ELG Program Plan 14. The corresponding preliminary plan, which is the subject of this briefing, is Preliminary ELG Program Plan 14.
  - Note that we should refer to the plans as "ELG Program Plans" rather than 304m Plans as CWA Section 304(m) only applies to direct dischargers. (Review of pretreatment standards is under CWA Section 304(g).) "ELG Program Plan" better represents that the plans are communications tools for our entire program while still meeting all requirements under 304(m).

Proposed Content of Preliminary ELG Program Plan 14

- [redacted]
-

[redacted]

- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]

- Introd[redacted]
  - [redacted]
  - [redacted]

[redacted]

Timeline for Next Steps and Key Milestones

[redacted]

6/18/18

Appendix

Statutory Background
(see legal framework attachment for specific statutory language and relevant case law)

- CWA sections 304(m)(1)(B) and (C) require the Administrator to identify industries discharging pollutants for which guidelines have not yet been published and to establish a schedule for promulgation of such guidelines (for direct discharging industries).
- CWA section 304(m)(1)(A) requires the Administrator to "establish a schedule for the annual review and revision of promulgated effluent guidelines."
- CWA section 304(b) requires the Administrator to "at least annually . . . revise, if appropriate" effluent guidelines.
- CWA section 307(b)(1) requires the Administrator to promulgate pretreatment standards (for indirect discharging industries).
- CWA section 304(g)(1) requires the Administrator to "review . . . annually . . . and, if appropriate, revise" pretreatment standards.
- CWA sections 304(m)(1) & (2) require the Administrator to publish a plan biennially, after public review and comment, establishing a schedule for the annual review and revision of existing effluent guidelines, as well as establishing a schedule for the promulgation of guidelines for any new industries identified by the Agency as warranting regulation. Promulgation of guidelines for any new industries identified shall be no later than 3 years after publication of the plan. (EAD presents its review and revision schedule for pretreatment standards in this plan, as well.)

6/18/18

Legal Framework for EPA's Effluent Limitations Guidelines Review and Revision Process

Subject	Relevant Clean Water Act Provision(s)	Notes
Effluent Limitations "Guidelines"	**Section 304(m)(1)**: "Within 12 months after February 4, 1987, and biennially thereafter, the Administrator shall publish in the Federal Register a plan that shall— (A) establish a schedule for the annual review and revision of promulgated effluent guidelines, in accordance with [section 304(b)]; (B) identify categories of sources discharging toxic or nonconventional pollutants for which guidelines under [section 304(b)(2) and section 316] have not previously been published; and (C) establish a schedule for promulgation of effluent guidelines for categories identified in subparagraph (B), under which promulgation of such guidelines shall be no later than . . . 3 years after the publication of the plan for categories identified in [plans published after Feb. 4, 1987]. **Section 304(m)(2)**: "The Administrator shall provide for public review and comment on the plan prior to final publication."	Regarding EPA's criteria for reviewing guidelines, see *Our Children's Earth Foundation v. EPA*, below. Regarding the promulgation of guidelines for new industries, see *Natural Resources Defense Council v. EPA*, below.
	Section 304(b), which is referenced in section 304(m), states: "For the purpose of adopting or revising effluent limitations . . . the Administrator shall . . . publish within one year of enactment of this title, regulations, providing guidelines for effluent limitations, and at least annually thereafter, revise, if appropriate, such regulations."	In 2010, environmental groups sued EPA, claiming that it had a mandatory duty to revise effluent guidelines for the steam electric generating industry within one year after the Agency announced its intent to begin such a rulemaking. EPA subsequently entered a consent decree with the litigants, which established a longer schedule for the rulemaking.
Effluent Limitations	**Section 301(b)(2)** requires effluent limitations for categories of point sources that are based on best available technology economically achievable, and **section 301(d)** states that "[a]ny effluent limitation required under [section 301(b)(2)] shall be reviewed at least every five years and, if appropriate, revised . . . ."	EPA's annual review of existing effluent guidelines includes a review of the effluent limitations contained within those guidelines.
Pretreatment Standards	**Section 307(b)(1)** requires the Administrator to publish regulations establishing pretreatment standards for introduction of pollutants into publicly owned treatment works for those pollutants which are determined not to be susceptible to treatment by such treatment works or which would interfere with the operation of such treatment works, and **section 304(g)** states that "the Administrator shall . . . review at least annually thereafter and, if appropriate, revise guidelines for pretreatment of pollutants . . . ."	For consistency and transparency, EPA annually reviews pretreatment standards in the same way it annually reviews effluent guidelines, and it describes its review and revision plans for pretreatment standards along with effluent guidelines in the 304(m) plan.

<u>Relevant Case Law</u>

Our Children's Earth Foundation v. U.S. EPA (9th Cir. 2008)

- Environmental groups sued EPA, claiming in part that it had a mandatory duty to review effluent guidelines and limitations using a technology-based approach, rather than a hazard-based approach. The Ninth Circuit considered whether this and other claims were properly brought under the citizen-suit provision of the CWA, which allows for suits where there is an alleged failure to perform a non-discretionary duty.
- The Court held that the Act does not require EPA to *review* existing effluent guidelines and limitations using a technology-based approach (although it does mandate a technology-based approach in the *promulgation or revision* of regulations). Thus, the Court found that the claim regarding EPA's effluent guidelines and limitations review criteria was not properly before it.
- The Court also held that (1) the Act does not require the publication of 304(m) plans to be synchronized with EPA's annual review or with the calendar year, and (2) while the identification of new categories of point source discharges is a non-discretionary duty, the precise number and kind of such categories identified is discretionary with the Administrator.

Natural Resources Defense Council v. U.S. EPA, 542 F.3d 1235 (9th Cir. 2008)

- Environmental groups sued EPA, claiming that it had a mandatory duty under section 304(m) of the CWA to promulgate ELGs and NSPSs for the construction and development point source category no later than three years after the Agency had listed the category (one for which ELGs and NSPSs had not yet been published) as a new category (as opposed to a revision of an existing ELG) in the 304(m) plan.
- Although the Agency had listed the construction category for rulemaking in its 304(m) plan in 2000, and subsequently published a proposed rule for the industry in 2002, it had since concluded that a rulemaking was not warranted because construction site storm water discharges were already being adequately addressed by existing regulations and the cost of the proposed ELGs was too high and disproportionate given the expected discharge reductions. Thus, in 2004, the Agency removed the construction industry from the 304(m) plan, stating that section 304(m)(1)(B)'s requirements apply only to categories that are discharging non-trivial amounts of toxic or nonconventional pollutants, and that discharges from the construction industry consist predominantly of conventional pollutants (TSS).
- In a decision affirming the district court, the Ninth Circuit held that the "unequivocal language" of the Act required the Agency to promulgate ELGs and NSPSs for the construction industry once it was listed as a new category in the 304(m) plan. The Court did not reach the question of whether EPA could avoid promulgating ELGs and NSPSs for a point source category that had, at one time, been included in a 304(m) plan, if the Agency "formally amended" the 304(m) plan that triggered the duty to promulgate or undertook some other "formal process to delist" the category.

- Since this decision, EPA has listed a new industry for an effluent guidelines rulemaking in the 304(m) plan and subsequently removed the industry from the plan, but only after providing public notice and an opportunity for comment on that decision. Nobody has challenged these actions.

6/18/18

List of Effluent Guidelines Promulgated by EPA

	Industrial Category	40 CFR	First Rulemaking	Last Revision
1	Dental Office	441	2017	2017
2	Oil and Gas Extraction	435	1975	2016
3	Steam Electric Power Generating	423	1974	2015
4	Construction and Development	450	2009	2014
5	Airport Deicing	449	2012	2012
6	Concentrated Animal Feeding Operations (CAFO)	412	1974	2008
7	Iron and Steel Manufacturing	420	1974	2005
8	Concentrated Aquatic Animal Production (Aquaculture)	451	2004	2004
9	Meat and Poultry Products	432	1974	2004
10	Centralized Waste Treatment	437	2000	2003
11	Metal Products and Machinery	438	2003	2003
12	Pharmaceutical Manufacturing	439	1976	2003
13	Coal Mining	434	1975	2002
14	Pulp, Paper and Paperboard	430	1974	2002
15	Landfills	445	2000	2000
16	Transportation Equipment Cleaning	442	2000	2000
17	Waste Combustors	444	2000	2000
18	Leather Tanning and Finishing	425	1982	1996
19	Pesticide Chemicals	455	1978	1996
20	Organic Chemicals, Plastics and Synthetic Fibers (OCPSF)	414	1987	1993
21	Nonferrous Metals Manufacturing	421	1976	1990
22	Nonferrous Metals Forming and Metal Powders	471	1985	1989
23	Aluminum Forming	467	1983	1988
24	Ore Mining and Dressing (Hard Rock Mining)	440	1975	1988
25	Battery Manufacturing	461	1984	1986
26	Copper Forming	468	1983	1986
27	Metal Finishing	433	1983	1986
28	Metal Molding and Casting (Foundries)	464	1985	1985
29	Porcelain Enameling	466	1982	1985
30	Plastics Molding and Forming	463	1984	1984
31	Sugar Processing	409	1974	1984
32	Coil Coating	465	1982	1983
33	Electrical and Electronic Components	469	1983	1983
34	Electroplating	413	1974	1983
35	Inorganic Chemicals Manufacturing	415	1982	1982
36	Petroleum Refining	419	1974	1982
37	Textile Mills	410	1974	1982
38	Timber Products Processing	429	1974	1981
39	Mineral Mining and Processing	436	1975	1979

40	Carbon Black Manufacturing	458	1976	1978
41	Canned and Preserved Fruits and Vegetable Processing	407	1974	1976
42	Explosives Manufacturing	457	1976	1976
43	Gum and Wood Chemicals Manufacturing	454	1976	1976
44	Hospitals	460	1976	1976
45	Photographic	459	1976	1976
46	Asbestos Manufacturing	427	1974	1975
47	Canned and Preserved Seafood (Seafood Processing)	408	1974	1975
48	Ink Formulating	447	1975	1975
49	Paint Formulating	446	1975	1975
50	Paving and Roofing Materials (Tars and Asphalt)	443	1975	1975
51	Soap and Detergent Manufacturing	417	1974	1975
52	Cement Manufacturing	411	1974	1974
53	Dairy Products Processing	405	1974	1974
54	Ferroalloy Manufacturing	424	1974	1974
55	Fertilizer Manufacturing	418	1974	1974
56	Glass Manufacturing	426	1974	1974
57	Grain Mills	406	1974	1974
58	Phosphate Manufacturing	422	1974	1974
59	Rubber Manufacturing	428	1974	1974

Message

From: Flanders, Phillip [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=0CB247EF96F642F98CB727A9ED48E49E-FLANDERS, P]
Sent: 5/1/2018 8:28:18 PM
To: Strassler, Eric [Strassler.Eric@epa.gov]
Subject: FW: 508 Version of ELG Review Report for Final 2016 Plan
Attachments: ELG Review Report Supporting Final 2016 Plan_FINAL_508.pdf

ERG prepared the Review Report for posting to the website. I forget where we left off on deciding to post this.

From: Kimberly Bartell [mailto:Kimberly.Bartell@erg.com]
Sent: Tuesday, May 01, 2018 4:25 PM
To: Flanders, Phillip <Flanders.Phillip@epa.gov>
Cc: Kim Wagoner <Kim.Wagoner@erg.com>
Subject: 508 Version of ELG Review Report for Final 2016 Plan

Hi Phillip,

Attached is the 508 version of the ELG Review Report supporting the Final 2016 Plan so it can be posted to the website.

Thanks,
Kim

Kim Bartell
Environmental Engineer
Eastern Research Group, Inc.
517-515-1721

United States
Environmental Protection
Agency

Effluent Guidelines Planning Review Report Supporting the Final 2016 Effluent Guidelines Program Plan

April 2018

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Washington, DC 20460

EPA-821-R-18-002

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1. INTRODUCTION TO EPA'S REVIEW SUPPORTING THE FINAL 2016 EFFLUENT GUIDELINES PROGRAM PLAN

Effluent limitations guidelines and standards (ELGs) are an essential element of the nation's clean water program, established by the 1972 amendments to the Federal Water Pollution Control Act (which then became known as the Clean Water Act (CWA)). ELGs are technology-based regulations used to control industrial wastewater discharges. This regulatory program substantially reduces industrial wastewater pollution and continues to be a critical aspect of the effort to clean the nation's waters.

EPA issues ELGs for new and existing sources that discharge directly to surface waters, as well as those that discharge to publicly owned treatment works (POTWs) (indirect dischargers). ELGs are typically applied in discharge permits as limits on the quantity of pollutants that facilities may discharge. To date, EPA has established ELGs to regulate wastewater discharges from 59 industrial point source categories. In addition to developing new ELGs, the CWA requires EPA to revise existing ELGs when appropriate. Over the years, EPA has revised ELGs in response to developments such as advances in treatment technology and changes in industry processes.

To fulfill CWA requirements, EPA conducts an annual review and effluent guidelines planning process. The review and planning process has three main objectives: (1) to review existing ELGs and to identify guidelines that are candidates for revision, (2) to identify new categories of direct dischargers for possible development of ELGs, and (3) to identify new categories of indirect dischargers for possible development of pretreatment standards.

This report documents EPA's methodology and evaluations from its review supporting the *Final 2016 Effluent Guidelines Program Plan* (Final 2016 Plan) (U.S. EPA, 2018). The Final 2016 Plan provides background on the CWA and ELG planning process, summarizes the results of this review, and details EPA's proposed actions and follow-up. The Final 2016 Plan also identifies any industrial categories newly selected for an effluent guideline rulemaking and provides a schedule for such rulemaking.

For this review, EPA:

- Considered public comments on the *Preliminary 2016 Effluent Guidelines Program Plan* (Preliminary 2016 Plan) (U.S. EPA, 2016).
- Continued its preliminary review of the discharge and treatment of pollutants from several point source categories identified for further review in the Preliminary 2016 Plan (U.S. EPA, 2016). These point source categories are Iron and Steel Manufacturing (40 CFR Part 420); Organic Chemicals, Plastics, and Synthetic Fibers (OCPSF) (40 CFR Part 414); and Pulp, Paper, and Paperboard (Pulp and Paper) (40 CFR Part 430). Specifically, EPA evaluated effluent concentrations, process operations contributing to discharges, and available treatment technologies for a subset of pollutants identified for further review.
- Continued its review of several point source categories brought to EPA's attention through public and stakeholder comments and input. These point source categories are Battery Manufacturing (40 CFR Part 461) and Electrical and Electronic

Components (E&EC) (40 CFR Part 469) (U.S. EPA, 2016). Specifically, EPA further evaluated recent changes within the industries, as well as potential new pollutant releases to the environment through industrial wastewater discharges that may not be adequately regulated by current ELGs.

- Initiated a preliminary review of miscellaneous food and beverage manufacturing sectors not currently regulated by national ELGs, to identify specific sectors that may require further review for the potential development of ELGs. Specifically, EPA analyzed current wastewater discharges, and for a subset of industry sectors, further evaluated sector processes and treatment characteristics.
- Continued investigating several pollutants/pollutant groups and general advances in industrial wastewater treatment, as identified in the *Final 2014 Effluent Guidelines Program Plan* (U.S. EPA, 2015). Specifically, EPA continued its (1) investigation of the manufacture and processing of engineered nanomaterials (ENMs) as a potential new source of industrial wastewater discharge; (2) review of industrial wastewater treatment technology data for inclusion in the Industrial Wastewater Treatment Technology (IWTT) Database; and (3) targeted review of pesticide active ingredient (PAI) discharges not currently regulated under the Pesticide Chemicals ELGs (40 CFR Part 455).

Section 2 of this report describes EPA's general methodology for evaluating available industrial wastewater discharge data, including effluent concentrations. Sections 4 through 6 present EPA's specific methodology and evaluations for each of the analyses described above.

1.1 Introduction References

1. U.S. EPA. (2015). *Final 2014 Effluent Guidelines Program Plan*. Washington, D.C. (July). EPA-821-R-15-001. EPA-HQ-OW-2014-0170-0210.

2. U.S. EPA. (2016). *Preliminary 2016 Effluent Guidelines Program Plan*. Washington, D.C. (June). EPA-821-R-16-001. EPA-HQ-OW-2015-0665-0290.

3. U.S. EPA. (2018). *Final 2016 Effluent Guidelines Program Plan*. Washington, D.C. (April). EPA-821-R-18-001. EPA-HQ-OW-2015-0665. DCN 08317.

2. INDUSTRIAL WASTEWATER DISCHARGE DATA: SOURCES, METHODOLOGY, AND QUALITY REVIEW

This section describes the data sources, general methodology, and EPA's quality review of available industrial wastewater discharge data, including discharge monitoring report (DMR), Toxics Release Inventory (TRI) and Canada's National Pollutant Release Inventory (NPRI) data.

EPA typically uses DMR and TRI data for its annual reviews as a screening tool to evaluate industrial wastewater discharges. For this review, EPA evaluated available DMR and TRI data as part of its continued evaluation of the Iron and Steel Manufacturing, Organic Chemicals, Plastics, and Synthetic Fibers (OCPSF), Pulp, Paper, and Paperboard (Pulp and Paper), Battery Manufacturing, Electrical and Electronic Components (E&EC), and Pesticides Chemicals point source categories, as well as miscellaneous food and beverage sectors. Section 2.1 describes the DMR and TRI data sources and EPA's quality review of the data. Sections 4, 5, and 6 describe EPA's specific analyses of the data related to these category and sector reviews.

For the Iron and Steel Manufacturing, OCPSF, and Pulp and Paper point source category reviews, EPA also evaluated data in Canada's NPRI. EPA assessed NPRI's usefulness as an additional data source that could indicate potential additional pollutants present in industrial wastewater discharges. Section 2.2 describes NPRI and EPA's quality review of the data. Section 4 presents EPA's analysis of the NPRI data as part of its continued review of these categories.

2.1 DMR and TRI Data

As a first step, EPA downloaded the 2014 TRI and DMR data from EPA's Water Pollutant Loading Tool (formerly the DMR Pollutant Loading Tool). EPA primarily used 2014 data because they represented the most recent and complete set of industrial wastewater discharge data available at the time of this review.

The Water Pollutant Loading Tool captures DMR data from the Integrated Compliance Information System for the National Pollutant Discharge Elimination System (ICIS-NPDES). These data include, but are not limited to facility-, outfall-, and monitoring-period specific concentrations, quantities, and flows and, where available, pollutant-specific permit limits for specific facilities. The Water Pollutant Loading Tool estimates the annual load of pollutants discharged (pounds per year) from specific facilities directly to surface water using DMR concentration and flow data.

The Water Pollutant Loading Tool also captures facility-specific direct and indirect pollutant water release estimates (pounds per year) reported to TRI. Due to TRI reporting requirements, the TRI dataset does not include flow rate information or underlying pollutant concentrations. However, facilities do report a basis of estimate (BOE) indicator to TRI. The BOE indicator provides a general indication of how the facility estimated its reported water release data. For instance, a BOE of "M1" or "M2" indicates the reported releases are based on monitoring data, a BOE of "C", "E1", or "E2" indicates the reported releases are based on mass balance calculations or emission estimates (U.S. EPA, 2014).

Although TRI and DMR data do not identify the effluent limitations guidelines and standards (ELGs) applicable to a particular facility, TRI classifies facilities based on industrial activity according to facility North American Industry Classification System (NAICS) codes, while ICIS-NPDES classifies facilities by Standard Industrial Classification (SIC) codes. The Water Pollutant Loading Tool relates each facility to a point source category using two established crosswalks that EPA developed for the purpose of its annual reviews:[1] "SIC/Point Source Category Crosswalk" and "NAICS/Point Source Category Crosswalk."[2]

The Water Pollutant Loading Tool also applies a pollutant-specific toxic weighting factor (TWF)[3] to the annual pollutant loads to calculate the relative toxic-weighted pound equivalents (TWPE) for each pollutant and total TWPE for all pollutants discharged at each facility.[4] The Water Pollutant Loading Tool then sums the total TWPE for the facilities in a particular point source category to provide a total TWPE for the category. EPA uses the TWPE to compare the relative toxicity of the point source categories and identify the pollutants and facilities within a category that are major contributors to the category's toxic discharges. As part of this review, EPA incorporated several revised TWFs into the Water Pollutant Loading Tool, as discussed in Section 2.1.1.

EPA also performed a quality review of the DMR and TRI data, as described in Section 2.1.2. EPA then imported the DMR and TRI data into a set of static databases, as described in Section 2.1.3. EPA used these static databases, as described in Section 2.1.4, to identify and/or obtain pollutant discharge concentration data. These databases formed the basis for EPA's analyses in the continued category reviews presented in Sections 4, 5, and 6.

For more information on the DMR and TRI data sources and the utility and limitations of their use in EPA's annual reviews, see Section 2.1 of the 2015 Annual Review Report (U.S. EPA, 2016a).

2.1.1 Toxic Weighting Factor Updates

During this review, EPA updated TWFs for seven chemicals: arsenic, cadmium, copper, manganese, mercury, thallium, and vanadium. These TWF revisions, shown in Table 2-1, are consistent with TWF revisions that EPA made as part of the Steam Electric Power Generating rulemaking in 2015 (ERG, 2015). EPA incorporated the TWF revisions into the Water Pollutant Loading Tool prior to downloading the 2014 DMR and TRI data. EPA did not develop new TWFs for chemicals that did not previously have a TWF (U.S. EPA, 2016b).

Table 2-1. Revised TWFs

Pollutant	TWF Calculation Update	Previous TWF	Revised TWF
Arsenic	Revised CPF.	4.04	3.47
Cadmium	Revised RfD (diet-based).	23.1	22.8
Copper	Revised BCF.	0.635	0.623

[1] For more information on how EPA relates each SIC and NAICS code to an industrial category, see Section 5.0 of the *Technical Support Document for the Annual Review of Existing Effluent Guidelines and Identification of Potential New Point Source Categories* (2009 Screening-Level Analysis (SLA) Report) (U.S. EPA, 2009).

[2] These crosswalks are available with the Water Pollutant Loading Tool documentation: https://cfpub.epa.gov/dmr/technical-support-documents.cfm.

[3] For more information on TWFs, see Toxic Weighting Factors Methodology (U.S. EPA, 2012a).

[4] Consistent with the methodology presented in the 2009 SLA Report (U.S. EPA, 2009).

Table 2-1. Revised TWFs

Pollutant	TWF Calculation Update	Previous TWF	Revised TWF
Iron	Revised RfD – EPA does not have a BCF to use in the HH calculation; therefore, RfD update does not change the TWF.	0.00560	0.00560
Manganese	Revised AQ benchmark.	0.0704	0.103
Mercury	Revise the fish consumption rate used to calculate HH for mercury to 0.0175 kg/day (same as other pollutants using the 2000 Methodology).	117	110
Thallium	Revised AQ benchmark; use the 2000 methodology. NRWQC updated in 2003 (U.S. EPA, 2003).	1.03	2.85
Vanadium	Revised AQ benchmark. Revised RfD – EPA does not have a BCF to use in the HH calculation; therefore, RfD update does not affect the TWF.	0.035	0.280

Source: (ERG, 2015)

Acronyms: AQ (aquatic life value); BCF (bioconcentration factor); CPF (cancer potency factor); HH (human health value); NRWQC (National Recommended Water Quality Criteria); RfD (reference dose); TWF (toxic weighting factor).

2.1.2 DMR and TRI Data Quality Review

Consistent with its methodology in previous annual reviews, and as described above, EPA downloaded the DMR and TRI data from the Water Pollutant Loading Tool. EPA conducted a general quality review of the completeness, accuracy, and reasonableness of the DMR and TRI data for the entire dataset. EPA then conducted a more focused quality review of the DMR and TRI data for the specific industry categories and pollutants evaluated during this review.

The *Technical Users Background Document for the Discharge Monitoring Report (DMR) Pollutant Loading Tool* (DMR Loading Tool Technical Users Document) describes the underlying ICIS-NPDES data extraction and calculation procedures used in the Water Pollutant Loading Tool. Section 5 of the DMR Loading Tool Technical Users Document describes the specific quality control procedures, which include completeness, comparability, accuracy, and reasonableness checks to identify and address any quality issues. The Water Pollutant Loading Tool extracts ICIS-NPDES data and calculates loadings on a weekly basis. Routine quality control procedures that are part of the weekly refresh include flagging potential outliers, and autocorrecting misreported units and unreasonable flow values (U.S. EPA, 2012b).

Similarly, the TRI program maintains data quality procedures to ensure that the reported TRI data are accurate and reliable. For example, each year the TRI data are analyzed for potential errors and the program may contact facilities concerning potentially inaccurate data. EPA's TRI program also provides instructions and guidance on facility reporting requirements (U.S. EPA, 2016c). The Water Pollutant Loading Tool extracts the TRI data on a yearly basis after they have been fully reviewed by the TRI program.

Though the underlying DMR and TRI datasets are routinely evaluated for data quality, EPA conducted additional data quality review steps to further evaluate the completeness, accuracy, and reasonableness of the relevant DMR and TRI data. The *Environmental*

Engineering Support for Clean Water Regulations Programmatic Quality Assurance Project Plan (PQAPP) describes the quality objectives in more detail (ERG, 2013). The sections below summarize EPA's additional data quality review steps performed for this review.

2.1.2.1 Data Quality Review and Corrections to the DMR Data

General quality review steps completed for the DMR data include checks for completeness, accuracy, and reasonableness across the entire DMR dataset, described below.

Completeness. To evaluate the data's completeness, EPA compared counts of facilities reporting DMR loadings data in the Water Pollutant Loading Tool in recent years, as shown in Table 2-2.

As discussed in the 2015 Annual Review Report, New Jersey has not converted to the current DMR data system (ICIS-NPDES), and thus, has not supplied EPA with required data about its NPDES discharge program since 2012 (U.S. EPA, 2016a). As a result, the DMR data are not complete nationwide. However, because the numbers of major and minor facilities reporting DMR data are otherwise similar between 2013 and 2014, EPA determined that the DMR data, as contained in the Water Pollutant Loading Tool, were usable for this review.[5]

Table 2-2. Results of the DMR Data Completeness Check

Number of Major Industrial Dischargers		Number of Minor Industrial Dischargers	
DMR 2013	DMR 2014	DMR 2013	DMR 2014
1,938	1,849	16,420	16,556

Sources: *DMRLTOutput2013_v1* and *DMRLTOutput2014_v1*.

Accuracy and reasonableness. To evaluate the accuracy and reasonableness of the DMR loadings data, EPA reviewed the database corrections from previous annual reviews to decide whether they should apply to the 2014 DMR discharges.

The Enforcement and Compliance History Online (ECHO) website[6] allows users of EPA datasets to identify and report DMR data updates and corrections through an integrated Error Report tool. Once submitted, error reports are routed to the appropriate EPA and State data stewards for evaluation and correction. As part of this review, EPA also reviewed the facility and pollutant discharges that had the greatest impact on total category loads in the Water Pollutant Loading Tool, based on toxic-weighted pounds discharged, to identify potential outliers. EPA reported potential DMR data outliers through the ECHO Error Report system for the data stewards to investigate and resolve. Any corrected data in ICIS-NPDES are automatically pulled into the Water Pollutant Loading Tool.

[5] Major discharges usually have the capability to impact receiving waters if not controlled and, therefore, have received more regulatory attention than minor discharges (U.S. EPA, 2010).

[6] See EPA's Enforcement Compliance History Online.

2.1.2.2 Data Quality Review and Corrections to the TRI Data

General quality review steps completed for the TRI water release data include checks for completeness, accuracy, and reasonableness across the entire TRI dataset, described below.

Completeness. To evaluate the data's completeness, EPA compared counts of facilities reporting TRI data in the Water Pollutant Loading Tool in recent years, as shown in Table 2-3. Because the number of facilities reporting is similar between 2013 and 2014, EPA determined that the TRI data contained in the Water Pollutant Loading Tool were useable for this review.

Table 2-3. Results of the TRI Data Completeness Check

Total Number of Facilities Reporting to TRI		Number of Facilities Reporting Discharges Greater than Zero to TRI	
TRI 2013	TRI 2014	TRI 2013	TRI 2014
19,601	19,986	6,936	7,067

Sources: *TRILTOutput2013_v1* and *TRILTOutput2014_v1*.

Accuracy and reasonableness. To evaluate the accuracy and reasonableness of the TRI data, EPA reviewed the database corrections from previous annual reviews to decide whether corrections made during previous reviews should apply to the 2014 TRI releases. EPA also verified that the Water Pollutant Loading Tool excluded pollutants that should not have an associated pollutant load (e.g., yellow or white phosphorus), as described in further detail in Section 3.4.2 in EPA's *2011 Annual Effluent Guidelines Review Report* (U.S. EPA, 2012c).

2.1.3 Generation of the DMR and TRI Databases

After they were downloaded and reviewed for quality, EPA incorporated the TRI and DMR data into a set of databases, described below, which are designed to preserve the integrity of the data and to support subsequent analyses integral to this review. These databases are static, while the Water Pollutant Loading Tool is based on a dynamic dataset that can change over time. For example, evolving reporting requirements may affect the population of facilities reporting to ICIS-NPDES and facilities may report data corrections as they are identified.

Consistent with previous annual reviews, EPA created the *DMRLTOutput2014_v1* and *TRILTOutput2014_v1* databases to aid in its review of the DMR and TRI pollutant loading data. EPA describes these databases below:

- *DMRLTOutput2014_v1* (DCN 08408): 2014 pollutant loadings (pounds per year) and TWPE for industrial facilities, calculated based on DMR data.
- *TRILTOutput2014_v1* (DCN 08409): 2014 direct and indirect water releases (pounds per year) and TWPE for industrial facilities, including a facility-reported BOE indicator.

2.1.4 Methodology for Obtaining Pollutant-Specific Concentration Data

For its continued reviews of the Iron and Steel Manufacturing, OCPSF, and Pulp and Paper point source categories, EPA also evaluated discharge (effluent) concentrations of a specific subset of pollutants identified for further review during the 2015 Annual Review (U.S.

EPA, 2016a).[7] As described in Section 2.1, concentration and flow rate information are not available in TRI. Therefore, EPA used 2014 DMR data to assess the pollutant-specific concentrations from direct discharges. For each of the three point source categories, EPA extracted available 2014 DMR concentration data from the Water Pollutant Loading Tool into a static database, *DMRLTConcOutput2014_v1* (DCN 08407) for further analysis.

Because some of the pollutants identified for further review are not regulated by the ELGs, limited DMR data are available. In addition, as described in 2.1, DMR data do not provide information regarding indirect discharges. To obtain additional information on direct and indirect pollutant discharge concentrations, EPA identified facilities that reported releases of the pollutants to TRI in 2014, focusing on those facilities that used monitoring data to estimate their reported releases. To obtain underlying concentration data for pollutants and facilities that were not represented in DMR data, EPA contacted several facilities that reported direct and/or indirect releases to TRI but did not have corresponding DMR data.

Sections 2.1.4.1 and 2.1.4.2 below describe EPA's general methodology for obtaining direct and indirect discharge concentration data, respectively. Section 4 describes EPA's methodology for reviewing concentration data for the three point source categories and pollutants identified for further review, including a list of facilities EPA contacted for each of the continued category reviews.

2.1.4.1 Direct Discharge Concentrations

EPA followed the steps below to evaluate DMR and obtain TRI direct discharge facility effluent concentration data for the relevant point source categories identified for further review (Iron and Steel, OCPSF, and Pulp and Paper).

1. *DMR Direct Discharge Concentration Data.* From *DMRLTConcOutput2014_v1*, EPA identified all external facility outfalls with monitoring-period-specific concentration data for each of the pollutants identified for further review.[8] A facility's permit specifies the frequency of concentration measurements, indicated by the monitoring period, e.g., daily, monthly, quarterly, biannually, or annually. Facilities may submit minimum, average, and/or maximum concentrations on their DMRs, depending on the type of limits in a permit. Facilities commonly submit monthly average and/or daily maximum concentrations. For the purposes of this review, EPA used minimum and monthly average concentration data.[9] EPA performed the following calculations on the concentration data:

   a. A facility may indicate a concentration submitted on a DMR as below the detection limit. In these cases, EPA used half of the detection limit as the

[7] Pollutants identified for further review are: lead, nitrate, copper, and manganese discharges in the Iron and Steel Manufacturing Category, total residual chlorine and nitrate discharges in the OCPSF Category, and lead, mercury, manganese, and hydrogen sulfide discharges in the Pulp and Paper Category.

[8] EPA did not use quantity data from *DMRLTConcOutput2014_v1* in its analyses.

[9] EPA used minimum concentration data for total residual chlorine discharges from OCPSF facilities only. See Section 4.2 for further details. EPA used monthly average concentration data for the remaining pollutants identified for review in the Iron and Steel, OCPSF, and Pulp and Paper categories.

monthly average concentration, consistent with EPA's annual review methodology for handling non-detect data (U.S. EPA, 2016d).[10]

b. EPA calculated an average yearly pollutant concentration specific to each outfall, based on reported monthly or quarterly average concentration data.

2. *TRI Direct Discharge Concentration Data*. Because flow rates and pollutant concentrations are not available in TRI, EPA contacted several facilities to obtain the underlying concentration data that formed the basis for their reported releases. For context, EPA also requested relevant information on process operations and wastewater treatment at the facilities. EPA identified facilities to contact using the following steps:

   a. From *TRILTOutput2014_v1*, EPA identified the facilities that reported direct releases of the pollutants identified for further review and that use monitoring data to estimate TRI releases. The use of monitoring data is indicated by a basis of estimate code of "M1" (estimate based on continuous monitoring data or measurements for the EPCRA section 313 chemical), or "M2" (estimate based on periodic or random monitoring data or measurements for the EPCRA section 313 chemical) (U.S. EPA, 2014).

   b. From *DMRLTOutput2014_v1*, EPA identified facilities that reported discharges of the pollutants identified for further review.[11]

   c. EPA identified facilities reporting direct releases of the pollutants to TRI in 2014 (from Step a) that did not report 2014 DMR discharges for the same pollutants (from Step b).

   d. EPA contacted a subset of facilities reporting each pollutant to TRI, based on facilities that 1) reported the highest releases to TRI, 2) use monitoring data to estimate TRI releases (identified from step a), and 3) do not have corresponding DMR data (identified from step c). EPA requested the underlying pollutant concentration data from these facilities, along with information on process operations that may result in releases and current treatment for the pollutant(s).

3. EPA compiled all 2014 concentration data obtained from DMRs and contacts with facilities reporting to TRI into separate spreadsheets for the Iron and Steel Manufacturing, OCPSF, and Pulp and Paper point source categories to facilitate the analyses described in Section 4 (ERG, 2016a, 2016b, 2016c).

[10] The Water Pollutant Loading Tool handles non-detect data similarly when calculating loadings using concentration and flow data.
[11] EPA did not use the *DMRLTConcOutput2014_v1* database as part of reviewing the TRI direct discharge data.

2.1.4.2 Indirect Discharge Concentrations

EPA followed the steps below to obtain effluent concentration data for facilities discharging to publicly owned treatment works (POTWs) for the point source categories identified for further review (Iron and Steel, OCPSF, and Pulp and Paper). TRI provides the only readily available source of information on indirect discharges.

1. *TRI Indirect Discharge Concentration Data.* Because flow rates and pollutant concentrations are not available in TRI, EPA contacted a subset of facilities reporting indirect releases to obtain the underlying concentration data. EPA identified facilities to contact using the following steps:

    a. From *TRILTOutput2014_v1*, EPA identified facilities that report indirect releases of pollutants identified for further review and that use monitoring data to estimate TRI releases, as indicated by a basis of estimate code of "M1" or "M2."

    b. EPA contacted a subset of facilities reporting each pollutant to TRI (identified from step a) to obtain underlying pollutant concentration data, along with information on process operations and current treatment for the pollutant(s) at the facilities before discharge to the POTW.

2. EPA compiled all 2014 indirect discharge concentration data obtained through contacts with facilities reporting to TRI into separate spreadsheets for the Iron and Steel Manufacturing, OCPSF, and Pulp and Paper point source categories to facilitate the analyses described in Section 4 (ERG, 2016a, 2016b, 2016c).

2.1.5 References for DMR and TRI Data Sources and Quality Review

1. ERG. (2013). Eastern Research Group, Inc. *Environmental Engineering Support for Clean Water Regulations Programmatic Quality Assurance Project Plan (PQAPP).* Chantilly, VA. (May). EPA-HQ-OW-2010-0824-0229.

2. ERG. (2015). Eastern Research Group, Inc. *Memorandum from Jill Lucy, Eastern Research Group, Inc. to Bill Swietlik, U.S. EPA. RE: Review of Toxic Weighting Factors in Support of the Final Steam Electric Effluent Limitations Guidelines and Standards (DCN SE04479).* Chantilly, VA. (September 21). EPA-HQ-OW-2015-0665. DCN 08404.

3. ERG. (2016a). Eastern Research Group, Inc. *Continued Preliminary Category Review – Facility Data Review and Calculations for Point Source Category – 414 – Organic Chemicals, Plastics and Synthetic Fibers.* Chantilly, VA. (September). EPA-HQ-OW-2015-0665. DCN 08486.

4. ERG. (2016b). Eastern Research Group, Inc. *Continued Preliminary Category Review – Facility Data Review and Calculations for Point Source Category – 420 –Iron and Steel Manufacturing.* Chantilly, VA. (September). EPA-HQ-OW-2015-0665. DCN 08429.

5. ERG. (2016c). Eastern Research Group, Inc. *Continued Preliminary Category Review – Facility Data Review and Calculations for Point Source Category – 430 – Pulp, Paper and Paperboard.* Chantilly, VA. (September). EPA-HQ-OW-2015-0665. DCN 08462.

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7. U.S. EPA. (2010). *U.S. EPA NPDES Permit Writers' Manual*. Retrieved from http://www3.epa.gov/npdes/pubs/pwm_2010.pdf. Washington, D.C. (September). EPA-833-K-10-001. EPA-HQ-OW-2010-0824-0236.

8. U.S. EPA. (2012a). *Toxic Weighting Factors Methodology*. Washington, D.C. (March). EPA-820-R-12-005. EPA-HQ-OW-2010-0824-0004.

9. U.S. EPA. (2012b). *Technical Users Background Document for the Discharge Monitoring Report (DMR) Pollutant Loading Tool Version 1.0*. Retrieved from http://cfpub.epa.gov/dmr/docs/Technical_Users_Background_Doc.pdf. Washington, D.C. (January). EPA-HQ-OW-2014-0170-0203.

10. U.S. EPA. (2012c). *The 2011 Annual Effluent Guidelines Review Report*. Washington, D.C. (December). EPA-821-R-12-001. EPA-HQ-OW-2010-0824-0195.

11. U.S. EPA. (2014). *Toxic Chemical Release Inventory Reporting Forms and Instructions, Revised 2014 Version*. Washington, D.C. (December). EPA 260-R-15-001. EPA-HQ-OW-2015-0665. DCN 08405.

12. U.S. EPA. (2016a). *The 2015 Annual Effluent Guidelines Review Report*. Washington, D.C. (June). EPA-821-R-16-002. EPA-HQ-OW-2015-0665-0299.

13. U.S. EPA. (2016b). *DMR Parameter and TRI Chemical Toxic Weighting Factors.* Washington, D.C. (September). EPA-HQ-OW-2015-0665. DCN 08406.

14. U.S. EPA. (2016c). Toxics Release Inventory Data Quality. Washington, D.C. Retrieved from https://www.epa.gov/toxics-release-inventory-tri-program/tri-data-quality. Accessed: September, 2016. EPA-HQ-OW-2015-0665. DCN 08411.

15. U.S. EPA. (2016d). *Memorandum from William Swietlik, U.S. EPA, to Public Docket for the Preliminary 2016 Effluent Guidelines Program Plan, EPA Docket Number EPA-HQ-OW-2015-0665. Re: Summary of Methodology for Handling Non-Detect Data: 304m and Steam Electric Power Generating*. (February 16). EPA-HQ-OW-2015-0665-0284.

2.2 Methodology for Comparing Canada's National Pollutant Release Inventory and the U.S. Toxics Release Inventory Pollutant Data

EPA compared available pollutant release data and reporting requirements from the U.S. TRI to the Canadian NPRI. The goal of this analysis was to identify potential additional pollutants that may be present in industrial wastewater discharges from iron and steel manufacturing, OCPSF, and pulp and paper facilities, but are not currently captured in EPA's data sources (i.e., TRI). Specifically, EPA identified the pollutants reported in both TRI and NPRI, as well as pollutants reported only in NPRI but not in TRI, for these specific point source categories. For pollutants reported only in NPRI, EPA compared the reporting requirements of the two programs to understand the reporting differences (e.g., differences/similarities in the reporting thresholds; inclusion of the same individual chemical compounds within groups of reportable chemicals, etc.). In addition, EPA compared the number of facilities reporting specific pollutants to NPRI to the total number of facilities reporting any water releases to NPRI, within a specific industry category, to provide an indication of each pollutant's potential prevalence in industrial wastewater throughout an industry category.

Section 2.2.1 provides background on the TRI and NPRI programs and their reporting requirements. Section 2.2.2 discusses EPA's data quality review of the TRI and NPRI data. Section 2.2.3 details EPA's methodology for obtaining and processing the NPRI data and compares the NPRI and TRI data for the three point source categories identified above. Sections 4.1, 4.2, and 4.3 include details on the specific NPRI and TRI comparison analyses and evaluations relevant to the Iron and Steel Manufacturing, OCPSF, and Pulp and Paper point source categories, respectively.

For more information on this comparative analysis, including a detailed summary of the TRI and NPRI reporting requirements and EPA's steps for comparing the TRI and NPRI data, see the memorandum *Comparison of Canada's National Pollutant Release Inventory and the Toxics Release Inventory Pollutant Data by Category for the Effluent Guidelines Planning Review Report Supporting the Final 2016 Effluent Guidelines Program Plan* (ERG, 2015).

2.2.1 TRI and NPRI Background and Overview of Reporting Requirements

Section 313 of the Emergency Planning and Community Right-to-Know Act requires facilities meeting specified thresholds to report to TRI their annual releases and other waste management activities for listed toxic chemicals. Facilities must report the quantities of toxic chemicals recycled, collected, combusted for energy recovery, treated for destruction, or otherwise disposed. Facilities must complete a separate report for each chemical manufactured, processed, or used in excess of the reporting threshold. EPA uses water release data reported annually to TRI in the ELG planning process as described in Section 2.1.

The NPRI is Canada's legislated, publicly accessible inventory of pollutant releases to air, water, and land; disposals; and transfers for recycling. The Canadian Environmental Protection Act 1999 requires facilities that manufacture, process, or otherwise use or release certain substances, and that meet reporting thresholds and other requirements to report their pollutant releases, disposals, and transfers annually to NPRI. In recent years, approximately 8,000 facilities report to NPRI (Environment Canada, 2013).

Table 2-4 provides a summary of the reporting requirements of TRI and NPRI.

Table 2-4. Reporting Requirements of TRI and NPRI

Inventory	Summary of Reporting Requirements	Chemical Universe
TRI	Facilities must meet three criteria to report to TRI:[a] • Be covered under a specific set of NAICS codes (related to mining, utilities, manufacturing, merchant wholesalers, wholesale electronic markets, publishing, hazardous waste, federal facilities). • Have 10 or more full-time employee equivalents. • Manufacture, process, or otherwise use any of the listed chemicals above an activity threshold (e.g., 25,000 pounds for non PBT chemicals).	• The TRI chemical list contains 688 reportable chemicals or chemical groups [b] • TRI requires reporting based on mass thresholds. • The 2013 TRI data include direct and indirect water releases associated with 256 of the 688 chemicals.[c]
NPRI	Facilities must meet one of the following criteria and the mass or concentration thresholds for one or more of the listed NPRI substances to report to NPRI:[d] • Have 10 or more employees, or • Perform certain activities, including incineration, wood preservation/pressure treatment, terminal operations, wastewater collection, pits and quarries operation, or pipeline installation.	• The NPRI Substance List contains 366 reportable chemicals.[e] • NPRI requires reporting based on the mass or concentration thresholds. • The 2013 NPRI data include direct and indirect water releases associated with 111 of the 366 reportable chemicals.[f]

Note: EPA relied on TRI and NPRI data for reporting year 2013 because those were the most recent data available on the same year basis in both data sets when the review began.
[a] Source: (U.S. EPA, 2016)
[b] Sources: (U.S. EPA, 2015a, 2015b)
[c] Source: *TRILTOutput2013_v1*
[d] Source: (Environment Canada, 2015a)
[e] Sources: (Environment Canada, 2014a)
[f] Source: (Environment Canada, 2014b)

2.2.2 TRI and NPRI Data Quality Review

For the initial TRI/NPRI comparison, EPA relied on TRI and NPRI data for reporting year 2013 because those were the most recent data available on the same year basis in both data sets when the review began. As part of its annual reviews, EPA routinely evaluates the utility and limitations of the TRI data. As part of the 2015 Annual Review, EPA completed a quality review of 2013 TRI data to identify and correct any outliers. See Sections 2.1.5 and 2.2 of EPA's 2015 Annual Review Report for a discussion of TRI data utility, limitations, quality review, and data corrections (U.S. EPA, 2016).

EPA's evaluation of the utility, limitations, and quality of the NPRI data, as they pertain to the TRI/NPRI data comparison, can be found in the *Comparison of Canada's National Pollutant Release Inventory and the Toxics Release Inventory Pollutant Data by Category for the Effluent Guidelines Planning Review Report Supporting the Final 2016 Effluent Guidelines Program Plan* memorandum (ERG, 2015). EPA presents a summary of the NPRI data utility and limitations below. The utility and limitations of the NPRI data are similar to TRI; therefore, the datasets can be readily compared.

2.2.2.1 NPRI Data Utility

In order to compare the NPRI data to the TRI data for use in the ELG planning process, EPA evaluated the utility and limitations of the NPRI data. Like the TRI data, the data collected in NPRI are useful for this comparison for the following reasons:

- NPRI is national in scope, including data from facilities across Canada.
- NPRI includes industrial releases to municipal sewage treatment plants (indirect releases), not just direct releases to surface water.
- NPRI identifies facilities by NAICS code, which can be used to match the data in TRI and facilitate the analysis of reporting differences and potential gaps in the TRI data associated with specific industrial categories.
- NPRI includes release data from many industrial categories.

2.2.2.2 NPRI Data Limitations

Similar to the TRI data, the limitations of the data collected in NPRI include the following (Environment Canada, 2015b):

- Many small establishments (fewer than 10 full-time equivalent employees) are not required to report (unless they meet another reporting criterion), nor are facilities that do not meet the reporting thresholds. Additionally, reporting is not required for any particular NAICS codes. Thus, facilities reporting to NPRI may be a subset of an industry.
- Release reports are, in part, based on estimates, not measurements. Facilities may use a number of methods to report releases, including estimating and direct measurement.
- NPRI only requires facilities to report certain chemicals; therefore, all chemicals discharged from a facility may not be captured.

2.2.3 General Data Processing Steps for the TRI/NPRI Comparison

As described in detail in the memorandum *Comparison of Canada's National Pollutant Release Inventory and the Toxics Release Inventory Pollutant Data by Category for the Effluent Guidelines Planning Review Report Supporting the Final 2016 Effluent Guidelines Program Plan* (ERG, 2015), EPA performed the following data processing steps on the 2013 TRI and NPRI data to compare the data:

- Obtained the 2013 TRI data from its *TRILTOutput2013_v1* database (DCN 08120) developed during the 2015 Annual Review (U.S. EPA, 2016).
- Downloaded the 2013 NPRI data from Environment Canada's NPRI website (Environment Canada, 2014b).
- Compiled the TRI and NPRI data into a common database, *NPRICompare2013* (DCN 08410).

- Identified and isolated releases to water.
- Identified facilities with reported pollutant releases to water greater than zero.
- Linked facility NAICS codes in both inventories to EPA's Industrial Point Source Categories.

Upon completing the data processing steps described above, EPA compared the NPRI and TRI data for the OCPSF, Iron and Steel Manufacturing, and Pulp and Paper point source categories to gauge the potential utility of the subsequent analyses. Table 2-5 compares the number of facilities and unique chemicals reported in each dataset for each point source category. As shown, although TRI contains information from many more facilities than NPRI in all of the three categories, in two of the three point source categories, NPRI and TRI contain data for a similar number of unique chemicals. Section 4 presents the results of the subsequent category-specific NPRI analyses.

Table 2-5. Facilities and Chemicals Listed in TRI and NPRI for Three Point Source Categories

PSC Code	Point Source Category	Number of Facilities		Number of Unique Chemicals	
		TRI	NPRI	TRI	NPRI
414	Organic Chemicals, Plastics, and Synthetic Fibers	647	43	174	42
420	Iron and Steel Manufacturing	215	19	41	45
430	Pulp, Paper, and Paperboard	226	69	43	41

Sources: *TRIOutput2013_v1*; *NPRICompare2013*

2.2.4 References for Methodology for Comparing Canada's National Pollutant Release Inventory and the U.S. Toxics Release Inventory Pollutant Data

1. Environment Canada. (2013). *Frequently Asked Questions and the National Pollutant Release Inventory (NPRI)*. Gatineau, QC. Retrieved from https://ec.gc.ca/inrp-npri/default.asp?lang=En&n=D874F870-1. (December 11). EPA-HQ-OW-2015-0665. DCN 08412.

2. Environment Canada. (2014a). *2014-2015 NPRI Substance List*. Gatineau, QC. Retrieved from https://www.ec.gc.ca/inrp-npri/E2BFC2DB-F6EF-4B59-8A68-4675F372A41A/2014%20-%202015%20NPRI%20Substance%20List_Liste%20des%20substances%20INRP%202014%20et%202015.xls. (November 28). EPA-HQ-OW-2015-0665. DCN 08414.

3. Environment Canada. (2014b). *Raw NPRI Data: Inventaire national des rejets de polluants 2013 / National Pollutant Release Inventory 2013*. Gatineau, QC. Retrieved from http://ec.gc.ca/inrp-npri/donnees-data/files/2013_INRP-NPRI_2014-09-16.xlsx. (September 16). Accessed: February 11, 2015. EPA-HQ-OW-2015-0665. DCN 08415.

4. Environment Canada. (2015a). *Guide for Reporting to the National Pollutant Release Inventory 2014 and 2015*. Gatineau, QC. Retrieved from https://www.ec.gc.ca/inrp-

npri/AFC98B81-A734-4E91-BD16-C5998F0DDE6B/2014-2015_NPRI_Guide.pdf. EPA-HQ-OW-2015-0665. DCN 08416.

5. Environment Canada. (2015b). *Guide for Using and Interpreting the National Pollutant Release Inventory (NPRI) Data*. Gatineau, QC. Retrieved from https://ec.gc.ca/inrp-npri/default.asp?lang=En&n=B5C1EAB8-1. (March 25). EPA-HQ-OW-2015-0665. DCN 08417.

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8. U.S. EPA. (2015b). *Changes To The TRI List Of Toxic Chemicals, Toxics Release Inventory Program*. Retrieved from http://www.epa.gov/sites/production/files/2015-03/documents/tri_chemical_list_changes_2_27_15.pdf. Washington, D.C. (February 27). EPA-HQ-OW-2015-0665-0251.

9. U.S. EPA. (2016). *The 2015 Annual Effluent Guidelines Review Report*. Washington, D.C. (June). EPA-821-R-16-002. EPA-HQ-OW-2015-0665-0299.

3. PUBLIC COMMENTS ON THE PRELIMINARY 2016 EFFLUENT GUIDELINES PROGRAM PLAN

EPA's annual review process considers information provided by the public and other stakeholders regarding the need for new or revised effluent limitations guidelines and standards (ELGs). Public comments received on EPA's prior reviews and plans helps the Agency prioritize its analysis of existing ELGs. This section presents a summary of the public comments and stakeholder input received on the *Preliminary 2016 Effluent Guidelines Program Plan* (Preliminary 2016 Plan).

3.1 Public Comments and Stakeholder Input

EPA published its Preliminary 2016 Plan and provided a 30-day public comment period starting on June 27, 2016 (see 81 FR 41535). The Docket supporting the *Final 2016 Effluent Guidelines Program Plan* (Final 2016 Plan) includes a complete set of the comments submitted, as well as the Agency's responses (see DCN 08521). EPA received 11 comment letters on the Preliminary 2016 Plan, representing 20 organizations. Table 3-1 presents a summary of these comments.

Commenting organizations representing industry included:

- United States Steel Corporation (U.S. Steel)
- American Exploration & Production Council (AXPC)
- American Petroleum Institute (API)
- The American Iron and Steel Institute (AISI)[12]
- Steel Manufacturers Association (SMA)
- Specialty Steel Industry of North America (SSINA)
- American Forest & Paper Association (AF&PA)

Commenting organizations representing environmental organizations included:

- Environmental Defense Fund (EDF)
- Clean Water Action[13]
- Environmental Integrity Project
- Partnership for Policy Integrity
- Sierra Club
- Delaware Riverkeeper Network
- Natural Resources Defense Council
- Upper Burrell Citizens Against Marcellus Pollution (UBCAMP)

[12] Three steel associations, AISI, SMA, and SSINA, collectively submitted public comments on the Preliminary 2016 Plan in one comment letter.

[13] Eight environmental organizations submitted public comments on the Preliminary 2016 Plan collectively in one comment letter. EDF was the only environmental organization to submit a separate public comment.

- Earthworks

Additionally, one non-profit trade association, Water Environment Federation (WEF), one organization representing publicly owned treatment works (POTWs), the National Association of Clean Water Agencies (NACWA), and two municipal entities, the Metropolitan Sewer District of Greater Cincinnati Industrial Waste Section (District), and the Orange County Sanitation District (Sanitation District), submitted comments.

EPA received seven comments on its proposed centralized waste treatment (CWTs) detailed study from two municipal entities, an organization representing POTWs, a non-profit trade association, two industry trade associations, and eight environmental organizations. The industry trade associations urged EPA to consider the study in the context of the newly revised ELGs for the Oil and Gas Extraction Category, and to recognize the benefits and importance of CWTs as one of the few options for wastewater management for the oil and gas industry. They also urged EPA to limit the study to those facilities defined as CWTs within 40 CFR Part 437, taking care to target the facilities that accept oil and gas wastewater, not the generators of the wastes accepted by the facilities. One of the industry trade associations also indicated that EPA must be more forthcoming about information related to the study, at a minimum including in the effluent guidelines plan the key criteria for the CWTs that are subject to the study.

The environmental organizations supported EPA's continuation of a detailed study of CWTs that accept oil and gas wastewaters and requested the study be expedited. The environmental organizations stated that the CWT ELGs are out of date due to developments in oil and gas exploration, changes in pollutants associated with stimulation and extraction techniques, and dramatic increases in produced water. In addition, the organizations indicated that CWTs may not have treatment in place for harmful constituents in oil and gas wastewaters such as radionuclides. Further, the organizations expressed concern regarding the potential increase in oil and gas wastewater sent to CWTs as a result of the revised ELGs for the Oil and Gas Extraction Category related to unconventional oil and gas extraction wastewater. The environmental organizations also provided information related to the Center for Sustainable Shale Development Discharge Standard and produced water volumes and discharge practices at CWTs.

The non-profit trade association, a municipal entity, and the organization representing POTWs indicated that EPA should reevaluate the scope and applicability of the CWT ELGs due to emerging markets for wastewater disposal. This would provide POTWs with valuable waste characterization information and an opportunity to expand the regulation to all waste types processed by a CWT operation. These organizations also commented EPA should address the Initial and Period Certification Statements dealing with dilution, non-limited pollutants of concern, and CWT wastes bypassing treatment but later combined for discharge, resulting in dilution. The non-profit organization, a municipal entity, and one environmental organization provided comment and information regarding CWT best management practices (BMPs) that EPA should consider.

EPA received three comments on its proposed continued preliminary review of the Metal Finishing Category (40 CFR Part 433) from a non-profit trade association, and two municipal entities. All three organizations supported EPA's continued study of the metal finishing industry.

The non-profit trade association and one of the municipal entities recommended adding pretreatment standards for 1,4-dioxane and N-Nitrosodimethylamine (NDMA), due to their impact on POTWs that may be engaged in resource recovery (direct and indirect water reuse and recycling), as well as the potential hazard to human health. The other municipal entity indicated that EPA should expand certain definitions and terminology in 40 CFR Part 433, such as phosphate conversion coating, passivation, and brush plating, and define new sources such as wet air pollution controls, new operations, and treatment and recycling technologies, to clarify the applicability of the existing ELG.

EPA received three comments regarding its request in the Preliminary 2016 Plan for new data and information on known transfers of wastewater originating from conventional oil and gas extraction facilities to POTWs; one comment from an industry trade association and two comments representing nine environmental organizations. The environmental organizations generally supported EPA's request for additional data regarding these transfers and provided information on the known volumes and characteristics of pollutants discharged to POTWs. The environmental organizations also supported EPA's request for information on well treatment and workover fluids in produced water. The industry trade association did not provide information about known discharges of conventional oil and gas wastewaters to POTWs, volumes, and/or characteristics, and they questioned EPA's request for information on conventional extraction and produced water discharges in the oil and gas industry. The industry trade association indicated that the distinction between conventional and unconventional oil and gas wastewater and activities is arbitrary, impractical, and problematic, and that EPA should have requested and reviewed information on conventional oil and gas extraction wastewater before issuing the rule related to unconventional oil and gas extraction wastewater. They further urged EPA to reach out to the oil and natural gas industry with questions, going forward.

EPA received two comments, representing four industry trade associations, on its review of the Iron and Steel Manufacturing Category (40 CFR Part 420). The industry trade associations did not support EPA's further review of the Iron and Steel Manufacturing Category, stating that the existing ELGs adequately control lead, and that revised guidelines for nitrate, manganese/manganese compounds and copper/copper compounds are not warranted. Further, they concurred with EPA's results that no further review is warranted for polychlorinated biphenyls (PCBs), cyanide, and fluoride because the discharge monitoring report (DMR) discharges from facilities are not representative of the effluent from facilities in the Iron and Steel Manufacturing Category (the discharges can be attributed to only a few facilities). The industry trade associations also suggested that EPA accept further comments on the Preliminary 2016 Plan and/or coordinate with the industry on any further reviews going forward.

EPA received comments from one industry trade association regarding its recently revised rule addressing wastewater discharges from unconventional oil and gas extraction (under 40 CFR Part 435). The organization urged EPA to abandon the distinction between produced water by conventional and unconventional formations and to take a holistic approach to the evaluation of produced water treatment regardless of formation characteristics. The industry trade association asserted that EPA's definition of "unconventional" is not necessarily consistent with various state or industry definitions and terminology, and that the definition of shale or tight formations is unclear, which may lead to confusion about what can be discharged to a POTW. The industry trade association urged EPA to withdraw the ELGs related to unconventional oil and gas extraction wastewater because EPA developed the definitions without collaborating with the impacted industry, states, or other stakeholders, and is only now soliciting information on conventional oil and gas extraction wastewaters after the publication of the ELGs related to unconventional oil and gas extraction. Further, the organization remains opposed to the permanent removal of the option to send unconventional oil and gas wastewater to POTWs, as this has the potential, in different economic circumstances and/or with the advent of improved treatment technologies, to become a viable alternative for the industry.

EPA received one comment from industry regarding its study of the Petroleum Refining Category (40 CFR Part 419). The industry trade association suggested that EPA provide a clear, data-supported justification for proceeding with the detailed study or discontinue the study. The commenter also encouraged EPA to engage petroleum refinery trade associations and stakeholders more fully if the study is to continue.

One industry trade association representing the pulp and paper industry expressed appreciation for EPA's efforts to collaboratively work with industry in reviewing the pollutants of concerned identified in the annual review.

EPA received one comment from a municipal entity in support of EPA's continued study of sapphire crystals and the applicability of the Electrical and Electronic Components Category (40 CFR Part 469) ELGs to sapphire crystals.

EPA received one set of comments from eight environmental organizations indicating that EPA's decision to delist Coalbed Methane Extraction from the ELG Plan was premature and suggesting that EPA reconsider in light of shifting gas prices, demand, and costs of wastewater treatment.

Lastly, EPA received three comments regarding its investigation of other point source categories not specifically mentioned in the Preliminary 2016 Plan. A non-profit trade association, along with a municipal entity, suggested EPA investigate Hospitals (40 CFR Part 460), Concentrated Animal Feeding Operations (CAFO) (40 CFR Part 412), and Concentrated Aquatic Animal Production/Aquaculture (40 CFR Part 451), and expand these categories to include pretreatment standards for high-risk pathogens and pharmaceuticals. The organization representing POTWs opposed EPA's decision in the 2015 Annual Review Report that no further review of the Landfills (40 CFR Part 445) Category was warranted. The organization indicated that landfill leachate, which quenches ultraviolet (UV) light during UV disinfection, has been a source of interference at POTWs. The organization representing POTWs urged EPA to study the Landfills Category further to decide if pretreatment standards for landfill leachate are warranted. The organization representing POTWs also recommended that EPA further review the Soap and Detergent Manufacturing (40 CFR Part 417) Category to reevaluate the need for pretreatment standards. The standards are over 40 years old and the organization indicated that their POTW members are able to handle higher loads from this category than are currently allowed.

Table 3-1. Comments on the Preliminary 2016 Effluent Guidelines Program Plan
EPA Docket Number: EPA-HQ-OW-2015-0665

No.	Commenter Name	Commenter Organization (Type of Commenter)	EPA Docket No.	Comment Summary
1	David L. Smiga	United States Steel Corporation (U.S. Steel) (industry organization)	0305	Urge EPA to accept comments throughout the review process or extend the comment period to at least 120 days. Suggest that the current ELGs for Iron and Steel Manufacturing (40 CFR Part 420) are adequate and further regulating lead, nitrate, manganese/manganese compounds, and copper/copper compounds or adding new substances to the ELGs is not warranted. Indicate that data for discharges of PCBs, cyanide, and fluoride are not representative of all discharges within the category and should not have categorical limits.
2	Nichole Saunders	Environmental Defense Fund (EDF), (environmental organization)	0306	Strongly support EPA's ongoing research regarding discharge of conventional and unconventional oil and gas wastewater through CWT facilities. Provide comments and information related to accuracy and completeness of the CWT facility list, the Center for Sustainable Shale Development Discharge Standard, and produced water volumes and discharge practices. Urge EPA to complete the CWT study and move forward quickly with drafting necessary changes to the ELGs. Provide information on wastewater volumes and pollutants and concentrations in wastewater from conventional oil and gas extraction. Support efforts to understand chemicals present in produced water. Encourage EPA to expeditiously finalize its rule covering unconventional oil and gas extraction and immediately proceed to develop an accompanying rule for conventional oil and gas extraction.
3	V. Bruce Thompson	American Exploration & Production Council (AXPC) (industry organization)	0307	Indicate that the CWT memorandum is old and does not provide sufficient information to public commenters in regard to EPA's CWT study. Urge EPA to refine its list of facilities and only include facilities that meet the 40 CFR Part 437 definition of a CWT. Further, urge EPA to only focus on the facilities themselves (and owners of those facilities) and not on the generators of the oil and gas wastes accepted by such CWT facilities. Recommend that EPA consider the study within the context of the newly revised ELGs for the Oil and Gas Extraction Category, recognizing the importance of CWT facilities to the oil and gas industry along with the necessary benefits they provide, as they are one of the few remaining options for wastewater disposal.

Table 3-1. Comments on the Preliminary 2016 Effluent Guidelines Program Plan
EPA Docket Number: EPA-HQ-OW-2015-0665

No.	Commenter Name	Commenter Organization (Type of Commenter)	EPA Docket No.	Comment Summary
4	Claudio H. Ternieden	Water Environment Federation (WEF) (non-profit trade association)	0308	Suggest EPA address dilution in the definition of Initial and Period Certification Statements in 40 CFR Part 437.41 in the content of a CWTs submittal to a POTW. Suggest EPA reevaluate the scope and applicability of the CWT ELGs to industries currently covered under 40 CFR Part 437 to provide an opportunity to expand the regulation to all waste types processed by a CWT operation. Urge EPA to expand data acquisition and analysis to enable development of effluent limits to be developed potentially for non-limited pollutants of concern that would otherwise not undergo treatment. For the Metal Finishing Category (40 CFR Part 433), recommend EPA establish pretreatment standards for 1,4-dioxane and N-Nitrosodimethylamine (NDMA). Suggest developing pretreatment standards for high-risk pathogens and pharmaceuticals under the Hospital (40 CFR Part 460), Concentrated Animal Feeding Operations (CAFO) (40 CFR Part 412), and Aquaculture (40 CFR Part 451) point source categories.
5	Cynthia A. Finley	National Association of Clean Water Agencies (NACWA) (organization representing POTWs)	0309	Recommend EPA expand the scope of the CWT study to include all CWT facilities and incorporate additional standards to prevent pass-through and interference with wastes that are subsequently sent to POTWs. Urge EPA to further study the Landfills Category (40 CFR Part 445), citing that some POTWs have experienced interference with UV disinfection of landfill leachate. Since more POTWs are moving to UV disinfection, this issue should be analyzed to decide if national pretreatment standards for landfill leachate are necessary. Recommend that EPA further study the Soap and Detergent Manufacturing Category (40 CFR Part 417) to decide if pretreatment standards developed for this category over 40 years ago are still needed. Several individual NACWA members have also raised concerns regarding the Hospital Category (40 CFR Part 460) and Pharmaceutical Manufacturing Category (40 CFR Part 439).

Table 3-1. Comments on the Preliminary 2016 Effluent Guidelines Program Plan
EPA Docket Number: EPA-HQ-OW-2015-0665

No.	Commenter Name	Commenter Organization (Type of Commenter)	EPA Docket No.	Comment Summary
6	Amy Emmert	American Petroleum Institute (API) (industry organization)	0310	Urge EPA to discontinue the study of the Petroleum Refining ELGs unless it can provide clear, data-supported justification. If EPA proceeds with the study, recommended engaging American Petroleum Institute (API), American Petrochemical Manufacturers Association (AFPM) and their member companies as the principally affected stakeholders. Raised several issues related to the final ELGs for unconventional oil and gas extraction wastewater study. Suggest EPA abandon the distinction between unconventional and conventional wells and further that EPA withdraw the ELGs because they should have known the definition would be problematic. Urge EPA to be more forthcoming about information related to the CWT study and to provide more opportunity for public comment. Suggest that EPA limit the CWT study to those facilities defined as CWTs under 40 CFR Part 437. When evaluating oil and gas wastewater, urge EPA to consider the benefits of CWTs. Indicate that EPA's request for information related to conventional oil and gas extraction was overly broad and requested during an insufficient comment period. Encourage EPA to reach out to the oil and natural gas industry with specific questions as they arise.
7	Jennifer Richmond	Metropolitan Sewer District of Greater Cincinnati Industrial Waste Section (District) (municipal entity)	0311	Support EPA's ongoing study of new sources related to Metal Finishing (40 CFR Part 433). Request EPA expand its definitions of the Metal Finishing (40 CFR Part 433) terminologies such as phosphate conversion coating, passivation, and brush plating, and define new sources, such as wet air pollution controls, new operations in metal finishing, and treatment and recycling technologies for wastewater to facilitate classification of new and existing sources. Support EPA's continued study of wastewater generated from the manufacturing of sapphire crystals and its applicability under the Electrical and Electronic Components Category (40 CFR Part 469).

**Table 3-1. Comments on the Preliminary 2016 Effluent Guidelines Program Plan
EPA Docket Number: EPA-HQ-OW-2015-0665**

No.	Commenter Name	Commenter Organization (Type of Commenter)	EPA Docket No.	Comment Summary
8	Jim Colston	Orange County Sanitation District (Sanitation District) (municipal entity)	0312	Suggest EPA address dilution in the definition of Initial and Period Certification Statements in 40 CFR Part 437.41 in the content of a CWTs submittal to a POTW. Suggest EPA reevaluate the scope and applicability of the CWT ELGs to industries currently covered under 40 CFR Part 437 to provide an opportunity to expand the regulation to all waste types processed by a CWT operation. Urge EPA to expand data acquisition and analysis to enable development of effluent limits to be developed potentially for non-limited pollutants of concern that would otherwise not undergo treatment. For the Metal Finishing Category (40 CFR Part 433), recommend EPA establish pretreatment standards for 1,4-dioxane and NDMA. Suggest developing pretreatment standards for high-risk pathogens and pharmaceuticals under the Hospital (40 CFR Part 460), CAFOs (40 CFR Part 412), and Aquaculture (40 CFR Part 451) point source categories.
9	Wayne J. D'Angelo	Kelley Drye & Warren, LLP (on behalf of American Iron and Steel Institute [AISI], Steel Manufacturers Association [SMA], and Specialty Steel Industry of North America [SSINA]) (industry organizations)	0313	Urge EPA to accept comments throughout the review process or extend the comment period to at least 120 days. Offered assistance in collecting and better understanding the discharge characteristics and treatment of options available to the iron and steel industry. Generally, indicate that the ELGs for the Iron and Steel Manufacturing Category are adequate and do not require revision. Support EPA's results that the discharges of PCBs, cyanide, and fluoride reported on DMRs are not representative of the overall Iron and Steel Manufacturing Category. Indicate that regulation of nitrates, manganese/manganese compounds, and copper/copper compounds is also unwarranted as the number of facilities reporting releases to TRI is the sole basis for EPA's decision to further review these pollutants and TRI data historically over-estimates the actual releases. Indicate that lead is already regulated and EPA identified the TWPE as relatively low.
10	Jerry Schwartz	American Forest & Paper Association (AF&PA) (industry organization)	0314	Appreciate EPAs efforts to resolve any questions or outstanding data needs for review of the Pulp, Paper, and Paperboard Category (40 CFR Part 430) through coordination with the industry.

Table 3-1. Comments on the Preliminary 2016 Effluent Guidelines Program Plan
EPA Docket Number: EPA-HQ-OW-2015-0665

No.	Commenter Name	Commenter Organization (Type of Commenter)	EPA Docket No.	Comment Summary
11	John Noël, Adam Kron, Dusty Horwitt, Nathan Matthews, Tracy Carluccio, Amy Mall, Ron Slabe, Bruce Baizel	Clean Water Action, Environmental Integrity Project, Partnership for Policy Integrity, Sierra Club, Delaware Riverkeeper Network, Natural Resources Defense Council, Upper Burrell Citizens Against Marcellus Pollution, Earthworks (environmental organizations)	0315	Support and recommend that EPA expedite its study and revision of the CWT ELGs (40 CFR Part 437) due to the potential increase in oil and gas wastewater sent to CWTs as a result of the recently revised ELGs related to unconventional oil and gas extraction. Suggest the CWT ELGs are out of date and offer inadequate protection for modern oil and gas extraction practices and the dramatic increase in produced water. Support EPA's decision to collect data and information on wastewater originating from conventional oil and gas extraction and known transfers to POTWs. Suggest new data sources for wastewater volume information in PA, WV, and CO Indicate that conventional oil and gas wastewater contains many of the same constituents as unconventional oil and gas wastewater, including those that make transfer to POTWs infeasible and dangerous. Support EPA's decision to collect data on produced water discharges from the oil and gas industry as it relates to 40 CFR Part 435, Subpart E, and suggested expansion of the scope of quantity, composition, and purpose research beyond the narrow subset of fluids labeled as "well treatment fluids" and "workover fluids." Recommend EPA expedite a parallel ELG update for coalbed methane extraction considering any inevitable shifts in gas prices, demand, and costs of wastewater treatment.

4. EPA'S CONTINUED PRELIMINARY REVIEW OF CATEGORIES IDENTIFIED FROM THE 2015 TOXICITY RANKING ANALYSIS

As part of its 2015 Annual Review, EPA conducted a toxicity ranking analysis (TRA) to identify, rank, and prioritize for further review, based on toxic-weighted pound equivalents (TWPE), point source categories with pollutant discharges that may pose a hazard to human health and the environment. See Section 2 of *The 2015 Annual Effluent Guidelines Review Report* (2015 Annual Review Report) for details on the TRA methodology (EPA-HQ-OW-2015-0665-0299). From the 2015 TRA and initial preliminary category reviews, EPA identified three point source categories for further review: Iron and Steel Manufacturing (40 CFR Part 420); Organic Chemicals, Plastics, and Synthetic Fibers (OCPSF) (40 CFR Part 414); and Pulp, Paper, and Paperboard (Pulp and Paper) (40 CFR Part 430) (EPA-HQ-OW-2015-0665-0290).

EPA continued its preliminary reviews of these three point source categories, focusing on the discharge and treatment of a subset of pollutants that contributed to a majority of each category's respective TWPE (i.e., pollutants of interest).

EPA documented the usability and quality of the data supporting its continued preliminary reviews of these point source categories and analyzed how the data could be used to improve the characterization of industrial wastewater discharges (e.g., the universe of facilities with known or potential discharges, concentration and quantity of pollutants, availability and performance of advances in wastewater treatment). See Appendix A of this report for more information on data usability and quality of the data sources supporting these reviews.

As a part of its review of these three point source categories, EPA also evaluated available data in the Canadian National Pollutant Release Inventory (NPRI) to identify additional pollutants that may potentially be present in industrial wastewater discharge in the U.S., as indicated by their presence in industrial wastewater discharges in Canada. Canada's NPRI is an analogous program to the Toxics Release Inventory (TRI) in the U.S. For more information on the general methodology, data sources, and limitations associated with EPA's analysis of the NPRI data, see Section 2.2 above.

Sections 4.1 through 4.3 of this report detail the methodology and evaluations from EPA's continued preliminary review of the Iron and Steel Manufacturing, OCPSF, and Pulp and Paper point source categories, respectively, including the category-specific evaluations from the NPRI analysis.

4.1 Iron and Steel Manufacturing (40 CFR Part 420)

As part of the 2015 Annual Review, EPA initiated a preliminary category review of the Iron and Steel Manufacturing Category because it ranked high, in terms of toxic-weighted pound equivalents (TWPE), in the final 2015 toxicity rankings analysis (TRA) (U.S. EPA, 2016a). EPA previously reviewed discharges from this category as part of the 2011 and 2013 Annual Reviews (U.S. EPA, 2012, 2014a).

From its 2015 TRA and preliminary category reviews, EPA decided that the Iron and Steel Manufacturing Category warrants further review, specifically related to the discharges of lead and lead compounds (lead), nitrate compounds (nitrate), and copper and copper compounds (copper), and manganese and manganese compounds (manganese) (U.S. EPA, 2016b). Of these pollutants, the Iron and Steel Manufacturing Category effluent limitations guidelines and standards (ELGs) establish limitations for only lead. As part of this review, EPA further evaluated the discharges of these pollutants to:

- Understand the process operations at iron and steel manufacturing facilities that generate the pollutants and how the facilities are currently managing their wastewater.
- Understand how permitting authorities currently regulate discharges of the pollutants.
- Decide if the concentrations of lead, nitrate, copper, or manganese in effluent discharges are present at levels that could be reduced by further treatment.
- Identify advances in industrial wastewater treatment technology performance for reducing discharges of the pollutants.
- Identify additional pollutants potentially present in facility industrial wastewater discharges in the U.S., not currently captured in discharge monitoring report (DMR) data or Toxics Release Inventory (TRI) data.

Section 4.1.1 provides a background of the Iron and Steel Manufacturing Category (40 CFR Part 420), and Section 4.1.2 provides a summary of the results of the previous ELG planning review related to the Iron and Steel Manufacturing Category. Sections 4.1.3 through 4.1.5 present EPA's current review approach and evaluation of the Iron and Steel Manufacturing Category, including results from EPA's continued review of the top pollutants in the category, evaluation of available treatment technology performance, and the results of the additional pollutant analysis. Section 4.1.6 summarizes EPA's current review of the Iron and Steel Manufacturing Category.

4.1.1 Iron and Steel Manufacturing Category Background

EPA first promulgated ELGs for the Iron and Steel Manufacturing Category (40 CFR Part 420) in 1974 (39 FR 24114) and made the last significant amendment to the rule in October 2002 (67 FR 64216). The Iron and Steel Manufacturing ELGs cover facilities that produce raw materials used in ironmaking and steelmaking or produce finished or semi-finished steel products (U.S. EPA, 2002). The Iron and Steel Manufacturing ELGs include 13 subcategories, listed in Table 4-1. Table 4-1 also includes the corresponding applicability and pollutants with limitations for each subcategory.

For the purpose of its ELG planning reviews, EPA generally considers facilities classified under the following seven North American Industry Classification System (NAICS) codes and four Standard Industrial Classification (SIC) codes to be part of the Iron and Steel Manufacturing Category, as identified from the NAICS-Point Source Category (PSC) and SIC-PSC crosswalks developed for the 304m review process (U.S. EPA, 2009):

- NAICS 331111: Iron and Steel Mills (including Cokemaking Facilities)
- NAICS 331210 (SIC 3317): Iron and Steel Pipe and Tube Manufacturing
- NAICS 331221 (SIC 3312): Rolled Steel Shape Manufacturing (Blast Furnace, Steel Works, and Rolling Mills)

- NAICS 331222 (SIC 3315): Steel Wire Drawing and Steel Nails
- Steelmaking facilities within the following NAICS codes:
  - NAICS 332618: Other Fabricated Wire Product Manufacturing
  - NAICS 332112: Nonferrous Forging (Blast Furnace, Steel Works, and Rolling Mills)
  - NAICS 332813 (SIC 3316): Electroplating, Plating, Polishing, Anodizing, and Coloring (Cold Rolled Steel) NAICS codes

Based on data in the 2002 *Development Document for Final Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category* (Iron and Steel Manufacturing Development Document), EPA estimated that there were 254 facilities with iron and steel manufacturing wastewater discharges in the Iron and Steel Manufacturing Category, with 133 facilities reporting direct releases to surface waters, 70 facilities reporting releases to publicly owned treatment works (POTWs), and 56 facilities reporting zero discharges (U.S. EPA, 2002).[14,15]

EPA identified 221 iron and steel manufacturing facilities reporting water releases to TRI in 2014, with 116 facilities reporting direct releases to surface waters, 52 facilities reporting indirect releases to POTWs, and 53 facilities reporting both direct and indirect releases (*TRILTOutput2014_v1*). EPA identified 70 iron and steel manufacturing facilities that submitted 2014 DMR data to the Integrated Compliance Information System for the National Pollutant Discharge Elimination System (ICIS-NPDES) (*DMRLTOutput2014_v1*). While these numbers appear to show a slight decline in the number of iron and steel manufacturing facilities discharging since the early 2000s, due to the limitations of the DMR and TRI datasets, EPA does not have an exact count of how many facilities currently are subject to the Iron and Steel Manufacturing ELGs. See Section 2.1 for a discussion on the limitations of DMR and TRI data.

[14] The total number of facilities (254) does not equal the sum of direct (133), indirect (70), and zero discharging (56) facilities due to instances where two sites are counted as one integrated facility (U.S. EPA, 2002).

[15] Zero dischargers are sites that do not discharge process wastewater and sites that are completely dry (i.e., do not use water in iron and steel operations) (U.S. EPA, 2002).

Table 4-1. ELG Applicability and Pollutants with Limitations for the Iron and Steel Manufacturing Category (40 CFR Part 420)

			Pollutants with Limitations														
Subpart	**Subcategory Title**	**Basis for ELG Applicability**	**Ammonia as N**	**Benzo(a)pyrene**	**Chromium**	**Cyanide**	**Lead**	**Naphthalene**	**Nickel**	**Oil and Grease**	**pH**	**Phenols (4AAP)**	**Tetrachloro-ethylene**	**Total Residual Chlorine**	**Total Suspended Solids**	**Zinc**	**2, 3, 7, 8- TCDF**
A	Cokemaking	Discharges to waters of the U.S. and the introduction of pollutants into a POTW from byproduct and other cokemaking operations.	X	X		X		X		X	X	X			X		
B	Sintering	Discharges to waters of the U.S. and the introduction of pollutants into a POTW from sintering operations conducted by heating iron-bearing wastes together with fine iron ore, limestone, and coke fines in an ignition furnace to produce an agglomerate for charging to the blast furnace.	X							X	X	X		X	X	X	X
C	Ironmaking	Discharges to waters of the U.S. and the introduction of pollutants into a POTW from ironmaking operations in which iron ore is reduced to molten iron in a blast furnace.	X			X	X			X	X	X		X	X	X	
D	Steelmaking	Discharges to waters of the U.S. and the introduction of pollutants into a POTW from steelmaking operations conducted in basic oxygen and electric arc furnaces.					X				X				X	X	
E	Vacuum Degassing	Discharges to waters of the U.S. and the introduction of pollutants into a POTW from vacuum degassing operations conducted by applying a vacuum to molten steel.					X				X				X	X	
F	Continuous Casting	Discharges to waters of the U.S. and the introduction of pollutants into a POTW from continuous casting of molten steel into intermediate or semi-finished steel products through water cooled molds.					X			X	X				X	X	

Table 4-1. ELG Applicability and Pollutants with Limitations for the Iron and Steel Manufacturing Category (40 CFR Part 420)

			Pollutants with Limitations														
Subpart	**Subcategory Title**	**Basis for ELG Applicability**	**Ammonia as N**	**Benzo(a)pyrene**	**Chromium**	**Cyanide**	**Lead**	**Naphthalene**	**Nickel**	**Oil and Grease**	**pH**	**Phenols (4AAP)**	**Tetrachloro-ethylene**	**Total Residual Chlorine**	**Total Suspended Solids**	**Zinc**	**2, 3, 7, 8- TCDF**
G	Hot Forming	Discharges to waters of the U.S. and the introduction of pollutants into a POTW from hot forming operations conducted in primary, section, flat, and pipe and tube mills.								X	X				X		
H	Salt Bath Descaling	Discharges to waters of the U.S. and the introduction of pollutants into a POTW from oxidizing and reducing salt bath descaling operations.			X	X			X		X				X		
I	Acid Pickling	Discharges to waters of the U.S. and the introduction of pollutants into a POTW from sulfuric acid, hydrochloric acid, or combination acid pickling operations.			X		X		X	X	X				X	X	
J	Cold Forming	Discharges to waters of the U.S. and the introduction of pollutants into a POTW from cold rolling and cold working pipe and tube operations in which unheated steel is passed through rolls or otherwise processed.			X		X	X	X	X	X		X		X	X	
K	Alkaline Cleaning	Discharges to waters of the U.S. and the introduction of pollutants into a POTW from operations in which steel and steel products are immersed in alkaline cleaning baths to remove mineral and animal fats or oils from the steel, and those rinsing operations which follow immersion.								X	X				X		
L	Hot Coating	Discharges to waters of the U.S. and the introduction of pollutants into a POTW from operations in which steel is coated with zinc, terne metal, or other metals by the hot dip process, and associated rinsing operations.			X		X			X	X				X	X	

Table 4-1. ELG Applicability and Pollutants with Limitations for the Iron and Steel Manufacturing Category (40 CFR Part 420)

			Pollutants with Limitations														
Subpart	Subcategory Title	Basis for ELG Applicability	Ammonia as N	Benzo(a)pyrene	Chromium	Cyanide	Lead	Naphthalene	Nickel	Oil and Grease	pH	Phenols (4AAP)	Tetrachloro-ethylene	Total Residual Chlorine	Total Suspended Solids	Zinc	2, 3, 7, 8- TCDF
M	Other Operations	Discharges to waters of the U.S. and the introduction of pollutants into a POTW from production of direct-reduced iron and from briquetting and forging operations.								X	X				X		

Source: 40 CFR Part 420

4.1.2 Summary of the Results of the 2015 Annual Review for the Iron and Steel Manufacturing Category

During the 2015 Annual Review, EPA identified discharges of lead, nitrate, manganese, and copper for further review. The paragraphs below summarize the results of EPA's previous review regarding these four pollutants (U.S. EPA, 2016b).

- *Lead.* One facility accounted for 19 percent of the TRI lead releases in 2013, with a TWPE of 4,360. The facility identified a data error in the indirect releases reported to TRI; correcting this error decreased the facility's lead TWPE to 1,100. After this correction, no individual facility in the 2013 DMR and TRI data discharged more than 2,300 TWPE of lead. However, due to the number of facilities reporting releases of lead to TRI and in DMRs in 2013 (133 facilities in TRI and 33 in DMRs), EPA concluded that further investigation of lead was appropriate to evaluate whether the Iron and Steel Manufacturing ELGs adequately control lead discharges.
- *Nitrate, copper, and manganese.* EPA also identified a number of facilities that reported releases of nitrate, copper, and manganese to TRI in 2013 (56, 114, and 79 facilities reported releases of nitrate, copper, and manganese, respectively). Because the Iron and Steel Manufacturing ELGs do not include limitations for these pollutants, EPA concluded that further investigations of nitrate, copper, and manganese were appropriate to evaluate whether control technologies are available to further reduce discharges.

4.1.3 Introduction to EPA's Current Evaluation of Specific Pollutants in the Iron and Steel Manufacturing Category

For the current review, EPA evaluated the discharges of lead, nitrate, copper, and manganese to satisfy the objectives outlined above in Section 4.1. Specifically, EPA:

- Evaluated available 2014 DMR and TRI data[16] for the four pollutants, including concentration data reported on DMRs.
- Contacted several iron and steel manufacturing facilities reporting releases of the four pollutants to TRI to gather information on process operations contributing to those releases, wastewater treatment technologies, and discharged concentrations.
- Reviewed the results and compared current discharge concentrations to concentrations achievable by technologies considered during the 2002 Iron and Steel Manufacturing Category rulemaking.
- Contacted state permitting authorities to further understand the development of pollutant permit limits and current processes for managing wastewater containing these pollutants.
- Researched the performance of available treatment technologies in the Industrial Wastewater Treatment Technology (IWTT) Database for the four pollutants.

[16] EPA evaluated 2014 data because it represented the most current and complete DMR and TRI dataset available at the start of this review. Note that EPA evaluated 2013 DMR and TRI data in support of the previous review.

- Reviewed available data in Canada's National Pollutant Release Inventory (NPRI) to identify any additional pollutants that may be present in iron and steel manufacturing wastewater discharges that are not reported in the U.S. under the TRI or DMR programs.

Table 4-2 compares the 2013 and 2014 TRI and DMR TWPE and the number of facilities reporting discharges of the four pollutants. Section 4.1.4 presents EPA's analyses and results related to lead, nitrate, copper, and manganese. Section 4.1.5 presents EPA's analysis of the NPRI data.

Table 4-2. 2013 and 2014 DMR and TRI TWPE and Number of Iron and Steel Manufacturing Facilities Discharging Lead, Manganese, Nitrate, and Copper

Pollutant	2014 TRI Data		2013 TRI Data		2014 DMR Data		2013 DMR Data	
	Number of Facilities [a]	TWPE	Number of Facilities [a]	TWPE	Number of Facilities [a]	TWPE	Number of Facilities [a]	TWPE
Lead	136	15,400	133	20,600	36	4,190	37	8,760
Manganese	115	13,000	114	5,680	8	2,140	8	1,760
Nitrate	57	27,700	56	25,400	3	329	3	502
Copper	84	5,020	79	4,990	30	2,650	34	3,760
Total for All Pollutants Reported	**221**	**85,900[b]**	**215**	**82,600[c]**	**70**	**116,000[b]**	**80**	**182,000[c]**

Sources: *TRILTOutput2014_v1*; *TRILTOutput2013_v1*; *DMRLTOutput2014_v1*; *DMRLTOutput2013_v1*.
Note: Sums of individual values may not equal the total presented, due to rounding.
[a] Number of iron and steel manufacturing facilities with TWPE greater than zero.
[b] EPA did not complete a comprehensive quality review of the remainder of the 2014 TRI and DMR data; therefore, this total may include outliers. See Section 2.1 for more information.
[c] Total includes corrected data as identified during the 2015 Annual Review (U.S. EPA, 2016a).

4.1.4 Iron and Steel Manufacturing Category Review of Lead, Nitrate, Copper, and Manganese

During the 2002 rulemaking, EPA collected information about the concentrations of lead, nitrate, copper, and manganese in iron and steel manufacturing discharges, and calculated, for certain subcategories, long-term averages (LTAs) reflecting various technology bases. These LTAs are the average performance level that a facility with well-designed and operated model pollution removal technologies is capable of achieving for the subcategory based on the data collected during the 2002 rulemaking.

For reasons cited in the Iron and Steel Manufacturing Development Document and 2002 final rule, and described briefly in the subsections below, EPA did not revise the ELGs for lead using the subcategorization scheme from the proposed rule and did not establish limitations for nitrate, copper, or manganese (see 67 FR 64216 and (U.S. EPA, 2002)). However, for the purpose of this preliminary category review, the LTAs developed as part of the proposed rule provide an indication of the performance of available technologies evaluated at the time of the rulemaking and serve as a useful basis for comparison and understanding of current lead, nitrate, copper, and manganese discharges. EPA notes that for many of the proposed subcategories, wastewater flow reduction steps, in concert with better performance of blowdown treatment systems, provided the primary basis for the proposed limitations and standards (67 FR 64216).

For this review, EPA obtained current direct and indirect discharge concentrations of lead, nitrate, copper, and manganese from iron and steel manufacturing facilities following the methodology outlined in Section 2.1.4. Specifically, EPA compiled average concentration data for nitrate, copper, and manganese reported on DMRs. Additionally, EPA identified and contacted 16 facilities to understand reported releases to TRI and gather underlying concentration data that formed the basis for the TRI-reported direct and indirect releases of lead, nitrate, copper, and manganese (compiled in ERG, 2016 and summarized below). EPA compared these concentration data to the LTAs achieved by technologies evaluated during the 2002 Iron and Steel Manufacturing rulemaking to provide a frame of reference for the magnitude of the discharges and to identify potential changes to discharges since 2002. For this analysis, EPA did not attempt to subcategorize the facility concentration data for a more specific comparison to the relevant LTAs. EPA compared the concentrations to the range of LTAs identified during the 2002 rulemaking across the subcategories.

Table 4-3 lists the facilities EPA contacted, along with information they provided regarding their process operations and treatment technologies. Nine facilities reported direct releases and seven reported indirect releases of one or more of the pollutants reviewed. Of these 16 facilities, EPA did not obtain concentration data from one direct discharger (IPSCO Tubulars Inc., Wilder, Kentucky) and three indirect dischargers (ADCOM Wire Co., Jacksonville, Florida; O&K American Corporation, Chicago, Illinois; and Jewel Acquisition LLC, Louisville, Ohio). EPA presents its analysis of the DMR and TRI-based concentration data for lead, nitrate, copper, and manganese in Sections 4.1.4.1 through 4.1.4.4, respectively.

To further understand discharges and treatment of lead, nitrate, copper, and manganese, EPA contacted two states, Indiana and West Virginia, that have a high proportion of iron and steel manufacturing facilities with reported lead, nitrate, copper, and/or manganese discharges. EPA also evaluated available treatment technology pollutant removal data. Sections 4.1.4.5 and 4.1.4.6 present the results of these analyses.

Table 4-3. Facilities Contacted to Obtain Underlying Concentration Data for Pollutant Releases Reported to TRI in 2014

Facility Name	Facility Location	Facility-Provided Process and Treatment Technology Information[a]	Direct or Indirect Releases	Pollutant(s)	Concentration Data Provided[b]	Reference
AK Steel Corp – Coshocton Works	Coshocton, OH	Nitrate discharges result from pickling of stainless steel, a process that uses a large amount of nitric acid.	Direct	Nitrate, Manganese	Yes	(Montag, 2016)
Arcelormittal Burns Harbor LLC	Burns Harbor, IN	No process or treatment technology information provided.	Direct	Lead	Yes	(Bley, 2016)
Arcelormittal Wierton LLC	Weirton, WV	Lead releases result from the tin plating process. Facility does not have treatment technologies installed to target the removal of lead. Copper and manganese are byproducts of the tin plating process and marked as an impurity.	Direct	Lead, Copper, Manganese	Yes	(Mieczkowski, 2016)
IPSCO Tubulars, Inc.	Wilder, KY	Facility contact did not respond.	Direct	Lead, Manganese	No	(Clifton, 2016)
NLMK Pennsylvania Corp	Farrell, PA	The facility is a steel mill and certain grades of steel that they roll can contain manganese. A small portion of the manganese generated is discharged in the wastewater, while the majority of it ends up in the sludge. Another source of manganese is the steel slabs that the facility purchases. The facility currently has clarifiers for settling, but no specific treatment technologies in place for manganese.	Direct	Manganese	Yes	(Herman, 2016)
USS Gary Works	Gary, IN	Releases result from sinter, iron and steel production, coke production, and rolling and finishing operations.	Direct	Lead, Nitrate, Copper, Manganese	Yes	(Lasko, 2016)
USS Mon Valley Works – Edgar Thompson Plant	Braddock, PA	Releases result from steel production, specifically from the caster.	Direct	Lead, Nitrate, Copper, Manganese	Yes	(Lasko, 2016)
USS Mon Valley Works – Irvin Plant	West Mifflin, PA	Releases result from hot rolling and finishing operations.	Direct	Lead, Nitrate, Manganese	Yes	(Lasko, 2016)
US Steel Corp – Fairfield Works	Fairfield, AL	Releases result from iron production and steel finishing.	Direct	Lead, Copper, Manganese	Yes	(Lasko, 2016)
ADCOM Wire Co.	Jacksonville, FL	The facility manufactures wire. Lead is found in the wastewater from the lead-wire base.	Indirect	Lead	No	(Killian, 2016)

Table 4-3. Facilities Contacted to Obtain Underlying Concentration Data for Pollutant Releases Reported to TRI in 2014

Facility Name	Facility Location	Facility-Provided Process and Treatment Technology Information[a]	Direct or Indirect Releases	Pollutant(s)	Concentration Data Provided[b]	Reference
Carpenter Technology Corp.	Reading, PA	Copper is introduced to the wastewater from plating and stripping operations. The facility performs chemical precipitation in order to treat the wastewater on-site before sending the discharges to the POTW.	Indirect	Copper	Yes	(McGowan, 2016)
DW–National Standard – Stillwater LLC	Stillwater, OK	Lead and copper releases result from raw materials used in carbon steel wire production.	Indirect	Lead, Copper	Yes	(Banks, 2016)
Jewel Acquisition LLC	Louisville, OH	The facility performs pickling operations with nitric acid that may result in discharges of lead, nitrate, copper, and manganese. The facility uses neutralization combined with settling for pretreatment before discharging wastewater to the POTW.	Indirect	Lead, Nitrate, Copper, Manganese	No	(Calderazzo, 2016)
O&K American Corporation	Chicago, IL	Lead and manganese releases result from steel wire production using an acid pickling operation. The facility has a conventional precipitation wastewater treatment system.	Indirect	Lead, Manganese	No	(Welsh, 2016)
SWVA, Inc.	Huntington, WV	Lead releases result from melting steel. Lead is not added but enters the wastewater from the melting of raw materials.	Indirect	Lead	Yes	(Artrip, 2016)
Valbruna Slater Stainless Steel	Fort Wayne, IN	Releases result from hot rolling and cold finishing operations.	Indirect	Copper, Manganese	Yes	(Hacker, 2016)

[a] This table reflects only the information provided by facility contacts.
[b] EPA compiled the concentration data provided by the facilities into a spreadsheet to support the analyses discussed in this section (ERG, 2016).

4.1.4.1 Evaluation of Lead Discharge Concentrations

During the 2002 Iron and Steel Manufacturing rulemaking, EPA evaluated discharges and calculated LTAs for lead reflecting technology bases for the proposed subcategories considered during the development of the rulemaking (see 65 FR 81963). Table 4-4 lists the technology bases and lead LTAs extracted from the Iron and Steel Manufacturing Development Document (U.S. EPA, 2002).

Table 4-4. 2002 Iron and Steel Manufacturing Rule Technology Bases and LTA Lead Values by Subcategory

Subcategory (Segment)	Option	Technology Basis	LTA for Lead (µg/L)
Non-Integrated Steelmaking and Hot Forming (Carbon and Alloy)	BAT	High-rate recycle systems and associated treatment for solids removal (scale pits, clarification, filtration), and water cooling prior to reuse. Multimedia (mixed media) filtration removes solids not removed by scale pits and clarification.	6.43
Finishing (Carbon and Alloy)	BAT	In-process technologies include flow reduction through countercurrent rinsing, recycle of fume scrubber water, and reuse of acid. End-of-pipe treatment includes oil removal, flow equalization, hexavalent chromium reduction (for certain waste streams), metals precipitation, gravity clarification, sludge dewatering.	7.54
Integrated Steel (Carbon and Alloy)	BAT	High-rate recycle using a scale pit with oil skimming, a roughing clarifier with oil skimming, sludge dewatering, a multimedia filter for polishing, and a cooling tower to lower the water temperature to acceptable levels to reuse and treatment of blowdown with multimedia filtration.	14.1
Integrated Steel (Stainless)	BAT	High-rate recycle using a scale pit with oil skimming, a roughing clarifier with oil skimming, sludge dewatering, a multimedia filter for polishing, and a cooling tower to lower the water temperature to acceptable levels to reuse and treatment of blowdown with multimedia filtration.	69.3

Source: (U.S. EPA, 2002)
BAT: Best Available Technology Economically Achievable

Evaluation of Direct Discharge Lead Concentrations

For this analysis, EPA obtained lead concentration data from 35 iron and steel manufacturing facilities: 28 from data reported on 2014 DMRs and seven from facilities reporting direct releases to TRI in 2014. Table 4-5 summarizes the average iron and steel manufacturing direct discharging facility 2014 DMR and TRI lead concentration data. EPA compared the range of facility concentrations shown in Table 4-5 to the lead LTAs from the 2002 rule listed in Table 4-4. The comparison shows that the median lead concentrations from DMR and TRI data are below the LTAs for all subcategories.

Table 4-5. Iron and Steel Manufacturing Facility 2014 Average Direct Discharge Lead Concentration Data

Data Type	Number of Data Points [a]	Average Lead Concentrations (µg/L)		
		Minimum	Median	Maximum
2014 Iron and Steel Facility DMR Data	59	0	2.50	114
2014 Iron and Steel Facility TRI Data	28	Non-detect	2.82	355

Source: *DMRLTConcOutput2014_v1*; (ERG, 2016)

[a] The number of data points represents the number of outfalls, not facilities. Some facilities have more than one outfall.

Evaluation of Indirect Discharge Lead Concentrations

For this analysis, EPA obtained lead concentration data from two iron and steel manufacturing facilities reporting indirect releases to TRI in 2014. Table 4-6 summarizes the average iron and steel manufacturing facility 2014 TRI lead concentration data being sent to POTWs. EPA compared these concentrations to the lead LTAs from the 2002 rule listed in Table 4-4. The comparison shows that SWVA Inc.'s average lead concentration is above the LTAs for all subcategories and DW – National Standard's average lead concentration is above the LTAs for all subcategories except the integrated steel subcategory, stainless segment. However, the concentrations listed in Table 4-6 represent concentrations from facilities reporting the highest indirect releases of lead to TRI.

Table 4-6. Iron and Steel Manufacturing Facility 2014 Average Indirect Discharge Lead Concentration Data

Facility Name and Location	Average Lead Concentration
SWVA, Inc., Huntington, WV	110 µg/L
DW – National Standard – Stillwater LLC, Stillwater, OK	59.8 µg/L

Source: (ERG, 2016)

4.1.4.2 Evaluation of Nitrate Discharge Concentrations

During the 2002 rulemaking, EPA evaluated discharges and calculated LTAs for nitrate reflecting technology bases for the proposed subcategories considered during the development of the rulemaking. Table 4-7 lists the technology bases and nitrate LTAs extracted from the Iron and Steel Manufacturing Development Document (U.S. EPA, 2002).

Table 4-7. 2002 Iron and Steel Manufacturing Rule Technology Bases and LTA Nitrate Values by Subcategory

Subcategory (Segment)	Option	Technology Basis	LTA for Nitrate (mg/L)
Finishing (Carbon and Alloy)	BAT	In-process technologies include flow reduction through countercurrent rinsing, recycle of fume scrubber water, and reuse of acid. End-of-pipe treatment includes oil removal, flow equalization, hexavalent chromium reduction (for certain waste streams), metals precipitation, gravity clarification, sludge dewatering.	0.114

Table 4-7. 2002 Iron and Steel Manufacturing Rule Technology Bases and LTA Nitrate Values by Subcategory

Subcategory (Segment)	Option	Technology Basis	LTA for Nitrate (mg/L)
Cokemaking (Byproduct Recovery)	PSES	Emission control scrubber blowdown to coke quench stations, oil and tar removal, flow equalization, free and fixed ammonia stripping, and post ammonia stripping equalization.	0.831
Integrated Steel (Stainless)	BAT	High-rate recycle using a scale pit with oil skimming, a roughing clarifier with oil skimming, sludge dewatering, a multimedia filter for polishing, and a cooling tower to lower the water temperature to acceptable levels to reuse and treatment of blowdown with multimedia filtration.	1.95
Cokemaking (Byproduct Recovery)	BAT	Emission control scrubber blowdown to coke quench stations, oil and tar removal, flow equalization, free and fixed ammonia distillation (stripping), indirect cooling, flow equalization, biological treatment and secondary clarification, sludge dewatering.	114

Source: (U.S. EPA, 2002)
BAT: Best Available Technology Economically Achievable
PSES: Pretreatment Standards for Existing Sources

Evaluation of Direct Discharge Nitrate Concentrations

For this analysis, EPA obtained nitrate concentration data from six iron and steel manufacturing facilities; two from data reported on 2014 DMRs and four from facilities reporting direct releases to TRI in 2014. Table 4-8 summarizes the average iron and steel manufacturing direct discharging facility 2014 DMR and TRI nitrate concentration data. EPA compared the range of facility concentrations shown in Table 4-8 to the nitrate LTAs from the 2002 rule listed in Table 4-7. EPA also contacted one facility that reported indirect releases of nitrate to TRI (Jewel Acquisition LLC, Louisville, Ohio), but was unable to obtain any data. This facility accounted for 56 percent of the 2014 TRI nitrate releases. Because EPA did not obtain any data on nitrate concentrations in indirect releases, the discussion below is limited to direct discharges.

The comparison to the LTAs (from Table 4-7) shows that the median nitrate concentrations in both data sets are above the finishing subcategory and cokemaking subcategory, PSES option LTAs, similar to the integrated steel subcategory LTA, and below the cokemaking subcategory, BAT option LTA. However, for this screening-level analysis, EPA did not identify and directly compare the individual facility discharges with the LTAs. EPA notes that the cokemaking subcategory, BAT option LTA, which includes biological treatment, is at least two orders of magnitude higher than the other subcategories (U.S. EPA, 2002).

Table 4-8. Iron and Steel Manufacturing Facility 2014 Average Direct Discharge Nitrate Concentration Data

Data Type	Number of Data Points [a]	Average Nitrate Concentrations (mg/L)		
		Minimum	Median	Maximum
2014 Iron and Steel Facility DMR Data	4	0.072	1.74	34.9
2014 Iron and Steel Facility TRI Data	12	0.221	1.44	35.9

Source: *DMRLTConcOutput2014_v1*; (ERG, 2016)

[a] The number of data points represents the number of outfalls, not facilities. Some facilities have more than one outfall.

4.1.4.3 Evaluation of Copper Discharge Concentrations

During the 2002 rulemaking, EPA evaluated discharges and calculated LTAs for copper reflecting technology bases for the proposed subcategories considered during the development of the rulemaking. For many subcategories considered, copper was either not detected or detected at low concentrations (U.S. EPA, 2002). Table 4-9 lists the technology bases and copper LTAs extracted from the Iron and Steel Manufacturing Development Document (U.S. EPA, 2002).

Table 4-9. 2002 Iron and Steel Manufacturing Rule Technology Bases and LTA Copper Values by Subcategory

Subcategory (Segment)	Option	Technology Basis	LTA for Copper (µg/L)
Integrated Steel (Stainless)	BAT	High-rate recycle using a scale pit with oil skimming, a roughing clarifier with oil skimming, sludge dewatering, a multimedia filter for polishing, and a cooling tower to lower the water temperature to acceptable levels to reuse and treatment of blowdown with multimedia filtration.	10.1
Finishing (Carbon and Alloy)	BAT	In-process technologies include flow reduction through countercurrent rinsing, recycle of fume scrubber water, and reuse of acid. End-of-pipe treatment includes oil removal, flow equalization, hexavalent chromium reduction (for certain waste streams), metals precipitation, gravity clarification, sludge dewatering.	21.0

Source: (U.S. EPA, 2002)
BAT: Best Available Technology Economically Achievable

Evaluation of Direct Discharge Copper Concentrations

For this analysis, EPA obtained copper concentration data from 28 iron and steel manufacturing facilities: 24 from data reported on 2014 DMRs and four from facilities reporting direct releases to TRI in 2014. Table 4-10 summarizes the average iron and steel manufacturing direct discharging facility 2014 DMR and TRI copper concentration data. EPA compared the range of facility concentrations shown in Table 4-10 to the copper LTAs from the 2002 rule listed in Table 4-9. The comparison shows that the median copper concentrations from DMR and TRI are similar to the integrated steel subcategory LTA and less than the finishing subcategory LTA. However, for this screening-level analysis EPA did not identify and directly compare the individual facility discharges with the LTAs.

Table 4-10. Iron and Steel Manufacturing Facility 2014 Average Direct Discharge Copper Concentration Data

Data Type	Number of Data Points [a]	Average Copper Concentrations (µg/L)		
		Minimum	Median	Maximum
2014 Iron and Steel Facility DMR Data	43	0.519	10.9	15,600[b]
2014 Iron and Steel Facility TRI Data	21	1.00	10.0	180

Source: *DMRLTConcOutput2014_v1*; (ERG, 2016)

[a] The number of data points represents the number of outfalls, not facilities. Some facilities have more than one outfall.

[b] This maximum data point is an outlier. Michigan Seamless Tube reported a yearly average discharge of 15.56 mg/L (15,560 µg/L) of copper, which is several orders of magnitude higher than the other concentration data points. The next highest data point is 0.112 mg/L (112 µg/L).

Evaluation of Indirect Discharge Copper Concentrations

For this analysis, EPA obtained copper concentration data from three iron and steel manufacturing facilities reporting indirect releases to TRI in 2014. Table 4-11 summarizes these average iron and steel manufacturing facility 2014 TRI copper concentration data being sent to POTWs. EPA compared these concentrations to the LTAs from the 2002 rule listed in Table 4-9. The comparison shows that the median copper concentration is above both subcategory LTAs shown in Table 4-9. However, the concentrations listed in Table 4-11 represent concentrations from facilities reporting the highest indirect releases of copper to TRI.

Table 4-11. Iron and Steel Manufacturing Facility 2014 Average Indirect Discharge Copper Concentration Data

Data Type	Number of Data Points [a]	Copper Concentrations (µg/L)		
		Minimum	Median	Maximum
2014 Iron and Steel Facility TRI Data	3	31.0	97.5	610

Source: (ERG, 2016)

[a] The number of data points represents the number of outfalls, not facilities. Some facilities have more than one outfall.

4.1.4.4 Evaluation of Manganese Discharge Concentrations

During the 2002 rulemaking, EPA evaluated discharges and calculated LTAs for manganese reflecting technology bases for the proposed subcategories considered during the development of the rulemaking. Table 4-12 lists the technology bases and manganese LTAs extracted from the Iron and Steel Manufacturing Development Document (U.S. EPA, 2002).

Table 4-12. 2002 Iron and Steel Manufacturing Rule Technology Bases and LTA Manganese Values by Subcategory

Subcategory (Segment)	Option	Technology Basis	LTA for Manganese (µg/L)
Other (Forging)	BPT	High-rate recycle, oil/water separation, and treatment of blowdown with multimedia filtration.	46.6
Finishing (Carbon and Alloy)	BAT	In-process technologies include flow reduction through countercurrent rinsing, recycle of fume scrubber water,	57.2

Table 4-12. 2002 Iron and Steel Manufacturing Rule Technology Bases and LTA Manganese Values by Subcategory

Subcategory (Segment)	Option	Technology Basis	LTA for Manganese (µg/L)
		and reuse of acid. End-of-pipe treatment includes oil removal, flow equalization, hexavalent chromium reduction (for certain waste streams), metals precipitation, gravity clarification, sludge dewatering.	
Integrated Steel (Stainless)	BAT	High-rate recycle using a scale pit with oil skimming, a roughing clarifier with oil skimming, sludge dewatering, a multimedia filter for polishing, and a cooling tower to lower the water temperature to acceptable levels to reuse and treatment of blowdown with multimedia filtration.	67.6
Other (Direct-Reduced Ironmaking (DRI))	BPT	High-rate recycle with solids removal using a classifier and clarifier, cooling, sludge dewatering, and treatment of blowdown with multimedia filtration.	1,250

Source: (U.S. EPA, 2002)
BPT: Best Practicable Control Technology Currently Available
BAT: Best Available Technology Economically Achievable

Evaluation of Direct Discharge Manganese Concentrations

For this analysis, EPA obtained manganese concentration data from 13 iron and steel manufacturing facilities: six from data reported on 2014 DMRs and 7 from facilities reporting direct releases to TRI in 2014. Table 4-13 summarizes the average iron and steel manufacturing direct discharging facility 2014 DMR and TRI manganese concentration data. EPA compared the range of facility concentrations shown in Table 4-13 to the manganese LTAs from the 2002 rule listed in Table 4-12. The comparison shows that the median manganese concentrations from DMR and TRI data are above three of the subcategory LTAs (other subcategory, forging segment, finishing subcategory, and integrated steel subcategory) and below the other subcategory, DRI segment LTA. However, for this screening-level analysis EPA did not identify and directly compare the individual facility discharges with the LTAs.

Table 4-13. Iron and Steel Manufacturing Facility 2014 Average Direct Discharge Manganese Concentration Data

Data Type	Number of Data Points[a]	Average Manganese Concentrations (µg/L)		
		Minimum	Median	Maximum
2014 Iron and Steel Facility DMR Data	17	49.0	259	1,900
2014 Iron and Steel Facility TRI Data	30	5.00	110	115,000[b]

Source: *DMRLTConcOutput2014_v1*; (ERG, 2016)

[a] The number of data points represents the number of outfalls, not facilities. Some facilities have more than one outfall.

[b] These data may contain outliers. US Gary Works reported 28.5 mg/L (28,500 µg/L) of manganese and US Edgar Thompson reported 115 mg/L (115,000 µg/L), which formed the basis for their TRI release estimates in 2014. These values are several orders of magnitude greater than the rest of the manganese concentrations.

Evaluation of Indirect Discharge Manganese Concentrations

For this analysis, EPA obtained manganese concentration data from one iron and steel manufacturing facility reporting indirect releases to TRI in 2014. Table 4-14 presents the average 2014 TRI manganese concentration data for this facility being sent to a POTW. EPA compared the concentration to the manganese LTAs from the 2002 rule listed in Table 4-12. The comparison shows that this facility's average concentration (265 µg/L) is above three of the subcategory LTAs (Other subcategory, forging segment, finishing subcategory, and integrated steel subcategory) and below the other subcategory, DRI segment LTA, similar to the direct discharges. However, the concentration data are from a facility reporting the highest indirect releases of manganese to TRI.

Table 4-14. Iron and Steel Manufacturing Facility 2014 Average Indirect Discharge Manganese Concentration Data

Facility Name and Location	Average Manganese Concentration
Valbruna Slater Stainless Steel, Fort Wayne, IN	265 µg/L

Source: (ERG, 2016; Hacker, 2016)

The review of facility direct and indirect concentration data discussed above showed that most of the concentration values are above the LTAs for manganese identified during the 2002 rulemaking. EPA followed up with two additional iron and steel manufacturing facilities with manganese discharges in the 2014 DMR data to further discuss sources and treatment of manganese. The facilities confirmed that they do not use manganese in their processes and were not able to identify the source of the manganese discharges in their wastewater. Both facilities suspect the discharges may result from background concentrations in the influent water they use. Additionally, neither facility specifically adds manganese as a wastewater treatment chemical (Gill, 2016; Smith, 2016).

4.1.4.5 Summary of Information Obtained from States Regarding Discharges of Lead, Nitrate, Copper, and Manganese

EPA contacted two state permitting authorities, Indiana Department of Natural Resources (IDNR) and the West Virginia Department of Environmental Protection (WV DEP), that have a high proportion of iron and steel manufacturing facilities with DMR discharges of lead, nitrate, copper, and/or manganese to collect additional information on the development of permit limits and help inform its understanding of the discharge of these pollutants, particularly since three of these pollutants (nitrate, copper, and manganese) do not have limitations established by the Iron and Steel Manufacturing ELGs.

Lead

The IDNR contact stated that because lead has technology-based limitations under the Iron and Steel Manufacturing ELGs, their focus is on evaluating whether a water-quality based limitation is needed by calculating a reasonable potential for lead to be present in the wastewater at a level requiring a water quality-based permit limit. The reasonable potential is determined using facility information and data provided with a permit application. The state contact indicated that lead is typically introduced at an iron and steel facility through metal finishing or other polishing operations. The contact also stated that iron and steel manufacturing facilities use well-established technologies for removing metals in their wastewater, generally removing the metals through solids removal (Rigney, 2016).

The WV DEP contact stated that permit writers compare lead concentrations from a facility permit application to water quality standards for lead and to the Iron and Steel Manufacturing ELGs, and the most stringent limit is applied in the facility permit. Further, according to the state contact, a facility's permit can have a mass-based lead limit to comply with the ELGs and a water quality-based concentration limit to comply with the water quality standards (Lockhart, 2016).

Nitrate

In Indiana, nitrate limits are based on water quality standards; if there is a drinking water intake downstream, the limits are based on the distance to the intake (Rigney, 2016).

In West Virginia, if the permit application contains nitrate discharges, the state will calculate a reasonable potential to discharge and apply the water quality standard (10 mg/L). If the discharge is very high, the state will set a performance-based limit for nitrate (Lockhart, 2016).

Copper

For both states, copper permit limits are based on water quality standards (Lockhart, 2016; Rigney, 2016). In Indiana, the state establishes water-quality-based effluent limits for copper using the tables of water quality criteria under 327 IAC 2 (Indiana General Assembly, 2016). The state contact indicated that solids removal removes metals from wastewater and the efficiency of removal is correlated to the pH of the system (Rigney, 2016).

Manganese

In Indiana, the discharge concentration data are compared to the water quality criteria (if there are any for the pollutant) to determine a reasonable potential to discharge, and the state sets a limit if needed. The Indiana state contact indicated that manganese is not typically added at iron and steel manufacturing facilities; it is a component of coal and could be a byproduct of coal combustion and other burnings (Rigney, 2016). In West Virginia, manganese permit limits are based on water quality standards (Lockhart, 2016).

4.1.4.6 Evaluation of Available Treatment Technology Performance Data for Lead, Nitrate, Copper, and Manganese

EPA reviewed recent literature compiled in the IWTT Database to identify emerging treatment technologies that are being evaluated and/or implemented within the iron and steel manufacturing industry, or that are being evaluated and/or implemented in other industries, specifically for the removal of lead, nitrate, copper, and manganese (for more information on the IWTT Database, see Section 6.2 of this report). EPA identified 21 articles that described removal of these pollutants, one of which was specific to the iron and steel manufacturing industry. Table 4-17, at the end of this subsection, summarizes these systems and their treatment effectiveness.

According to information collected during the 2002 Iron and Steel Manufacturing rulemaking, the industry extensively uses physical/chemical treatment technologies. Physical/chemical treatment can effectively remove pollutants such as TSS, oil and grease, heavy organics (tars), ammonia, cyanide, and metals. EPA also identified biological treatment technologies used in the industry, particularly for the cokemaking sector, targeted for removal of organics and nutrients (U.S. EPA, 2002). Table 4-15 lists the general chemical/physical and biological treatment technologies EPA identified in place in the iron and steel manufacturing industry during the 2002 rulemaking.

Table 4-15. Chemical/Physical and Biological Treatment Technologies Used by the Iron and Steel Manufacturing Industry in 2002

Treatment Technology Type	Applicable Technologies
Chemical/Physical	• Equalization • Tar removal • Free and fixed ammonia distillation (stripping) • Cooling towers • Shell-and-tube heat exchangers • Alkaline chlorination/breakpoint chlorination • Cyanide precipitation • Ozone oxidation • Gravity flotation • Oil/water separation • Chemical emulsion breaking and dissolved air flotation • Ultrafiltration • Carbon dioxide injection • Hexavalent chromium reduction • Chemical precipitation • Ion exchange • Scale pits with oil skimming • Classifiers • Clarification/sedimentation • Microfiltration • Multimedia filtration • Granular activated carbon
Biological	• Biological nitrification using conventional activated sludge • Biological nitrification using sequencing batch reactors (SBRs) • Biological nitrification using attached growth • Biological denitrification

Source: (U.S. EPA, 2002)

EPA identified in IWTT a variety of wastewater treatment technologies that have recently been investigated as treatments for lead, nitrate, copper, and manganese, summarized in Table 4-17, though most are pilot-scale. Much of the treatment performance data for these technologies address metal removals, and, except for seven systems, achieve removal rates greater than 82 percent. Effluent concentrations for lead, nitrate, copper, and manganese were not consistent across the identified studies.

Table 4-16 summarizes the effluent concentrations from the studies identified in IWTT (detailed in Table 4-17) and the range of LTA concentrations considered during the 2002 Iron and Steel Manufacturing rulemaking for lead, nitrate, copper, and manganese.

As shown in Table 4-16 and Table 4-17, effluent concentrations of lead identified from studies in IWTT are generally less than, but on the same order of magnitude and as the range of the LTA lead concentrations identified for the 2002 rulemaking. Two of the four studies listed in Table 4-17 show concentrations lower than the median lead concentrations identified from the 2014 DMR and TRI direct discharge data (0.0025 mg/L and 0.00282 mg/L, respectively), however, EPA notes that the performance data were not specific to the treatment of iron and steel manufacturing wastewater.

Effluent concentrations of nitrate from studies in IWTT are generally of the same order of magnitude as the range of LTA nitrate concentrations identified for the 2002 rulemaking for all but the cokemaking subcategory, BAT option, which is two orders of magnitude higher than the other subcategory LTAs. Similarly, a comparison of the 2002 LTA range (without the cokemaking subcategory, BAT option) and the concentrations achieved in the IWTT studies showed one study achieved concentrations below the LTA range. In addition, several of the studies listed in Table 4-17 show concentrations lower than the median nitrate concentrations identified from the 2014 DMR and TRI direct discharge data (1.74 mg/L and 1.44 mg/L, respectively), however, EPA notes that the performance data were not specific to the treatment of iron and steel manufacturing wastewater.

Effluent concentrations of copper from studies in IWTT are generally of the same order of magnitude as the range of the LTA copper concentrations identified for the 2002 rulemaking. Two studies achieved copper concentrations below the copper LTA range. In addition, several of the studies listed in Table 4-17 show concentrations below the median copper concentrations identified from the 2014 DMR and TRI direct discharge data (0.0109 mg/L and 0.01 mg/L, respectively). EPA notes that only one of the studies in IWTT was specific to the treatment of iron and steel manufacturing wastewater and the reported effluent concentration of copper was the highest among the studies in IWTT (<2 mg/L) and two orders of magnitude higher than the LTAs identified for the 2002 rulemaking and DMR and TRI concentrations.

Of the treatment technology performance data for manganese removal in IWTT, only one study showed effluent manganese concentrations lower than the range of LTA manganese concentrations identified for the 2002 rulemaking, however, it was applied to petroleum refinery wastewater and was pilot scale. In general, manganese effluent concentrations observed from the studies in IWTT are also higher than, or the same order of magnitude as the median manganese concentrations identified from the 2014 DMR and TRI direct discharge data (0.259 mg/L and 0.11 mg/L, respectively), however, EPA notes the performance data were not specific to the treatment of iron and steel manufacturing wastewater.

Table 4-16. Treatment Technology Performance Data and LTA Values for Lead, Nitrate, Copper, and Manganese

Parameter	Lead (mg/L)	Nitrate (mg/L)	Copper (mg/L)	Manganese (mg/L)
LTA Concentrations by Subcategory (Segment)				
Non-Integrated Steelmaking and Hot Forming (Carbon/Alloy)	0.00643	-	-	-
Finishing (Carbon/Alloy)	0.00754	0.114	0.021	0.0572
Integrated and Stand-Alone Hot Forming (Carbon/Alloy)	0.0141	-	-	-
Integrated and Stand-Alone Hot Forming (Stainless)	0.0693	1.95	0.0101	0.0676
Cokemaking (Byproduct Recovery), PSES Option 1	-	0.831	-	-
Cokemaking (Byproduct Recovery), BAT Option 1	-	114	-	-
Other (Forging)	-	-	-	0.0466
Other (Direct-Reduced Ironmaking (DRI))	-	-	-	1.25
Range of IWTT Concentration Data shown in Table 4-17				
Minimum Effluent Concentration	< 0.001	0.01	0.00223	< 0.01
Maximum Effluent Concentration	0.0528	2.8	< 2.0	1.77

Source: (U.S. EPA, 2002)

Table 4-17. Summary of Wastewater Treatment Technologies for Lead, Nitrate, Copper, and Manganese

Parameter	Wastewater Treatment Technology (Order of Unit Processes)	Effluent Concentration (mg/L)	Percent Removal	Industry	Treatment Scale	Reference
Lead	Membrane bioreactor	0.001	76.7%	Metal Finishing	Pilot	(Buckles, et al., 2003)
	Bag and cartridge filtration, oil/water separation, flow equalization, membrane filtration	0.004	95.0%		Pilot	(Pugh, et al., 2014)
	Membrane bioreactor, Aeration	0.0528	96.7%	Ore Mining and Dressing	Pilot	(Progress, et al., 2012)
	Mechanical pre-treatment, flow equalization, oil/water separation, membrane bioreactor, adsorptive media	< 0.001	>76.7%	Transportation Equipment Cleaning	Full	(Buckles, et al., 2007)
Nitrate	Adsorptive media	2	50.0%	Petroleum Refining	Full	(Hayes & Sherwood, 2012)
	Membrane filtration, ion exchange, and reverse osmosis	2.8	88.8%		Pilot	(Ginzburg & Cansino, 2009)
	Aerobic fixed film biological treatment	NR	< 100%	Coal Mining	Full	(Reinsel, 2010)
	Flow equalization, membrane filtration, and reverse osmosis	0.42	97.5%	Ferroalloy Manufacturing	Pilot	(Benito & Ruiz, 2002)
Nitrate (as N)	Anaerobic fixed film biological treatment and membrane filtration	0.01	99.9%	Coal Mining	Pilot	(Munirathinam, et al., 2011)
	Anaerobic fixed film biological treatment and moving bed bioreactor	0.7	97.7%		Pilot	(Gay, et al., 2012)
	Ozonation	1.8	10.0%	Textile Mills	Pilot	(Somensi, et al., 2010)
	Granular-media filtration, membrane filtration, and reverse osmosis	0.73	51.3%	Electrical and Electronic Components	Pilot	(Huang, et al., 2011)
Copper	Electrocoagulation	NR	95.0%	Electrical and Electronic Components	Pilot	(Kim, et al., 2012)
	Flow equalization, membrane filtration, and reverse osmosis	0.12	93.3%	Ferroalloy Manufacturing	Pilot	(Benito & Ruiz, 2002)
	Membrane bioreactor	0.0105	70.5%	Metal Finishing	Pilot	(Buckles, et al., 2003)
	Bag and cartridge filtration, oil/water separation, flow equalization, and membrane filtration	< 0.025	> 95.0%		Pilot	(Pugh, et al., 2014)

Table 4-17. Summary of Wastewater Treatment Technologies for Lead, Nitrate, Copper, and Manganese

Parameter	Wastewater Treatment Technology (Order of Unit Processes)	Effluent Concentration (mg/L)	Percent Removal	Industry	Treatment Scale	Reference
	Biologically active filters	NR	95.0%	Nonferrous Metals Manufacturing	Pilot	(Diels, et al., 2003)
	Membrane bioreactor and aeration	0.0042	99.3%	Ore Mining and Dressing	Pilot	(Progress, et al., 2012)
	Adsorptive media	0.00223	96.8%	Steam Electric Power Generating	Pilot	(Aldave & Buday, 2011)
	Mechanical pre-treatment, flow equalization, oil/water separation, membrane bioreactor, and adsorptive media	0.011	69.1%	Transportation Equipment Cleaning	Full	(Buckles, et al., 2007)
Copper, total	Flow equalization, chemical precipitation, clarification, (repeated in sequence) granular-media filtration, granular activated carbon unit, ion exchange, and reverse osmosis	< 0.02	> 99.5%	Aluminum Forming	Full	(Patrick, et al., 2008)
	Chemical precipitation, aeration, and ballasted clarification	< 2	> 96.4%	Iron and Steel Manufacturing	Pilot	(Kessler, 2002)
Manganese	Aerobic fixed film biological treatment, chemical precipitation, and powdered activated carbon	0.15	53.1%	Metal Finishing	Pilot	(Ahmad, et al., 2010)
	Chemical precipitation, dissolved air flotation, and granular-media filtration	0.23	98.6%	Ore Mining and Dressing	Pilot	(Colic & Hogan, 2012)
	Membrane bioreactor and aeration	1.77	82.0%		Pilot	(Progress, et al., 2012)
	Constructed wetlands	NR	92.5%	Steam Electric Power Generating	Pilot	(Morrison, et al., 2011)
	Membrane filtration, ion exchange, and reverse osmosis	< 0.01	> 83.3%	Petroleum Refining	Pilot	(Ginzburg & Cansino, 2009)

NR – Not Reported

4.1.5 Iron and Steel Manufacturing Category NPRI Analysis

EPA evaluated the utility of using data from Canada's NPRI to identify potential additional pollutants that may be present in industrial wastewater discharges from facilities in the U.S., as indicated by their presence in industrial wastewater discharges from facilities in Canada. Section 2.2 of this report provides a general overview of the NPRI analyses and methodology. This section presents EPA's review of the NPRI data specific to the Iron and Steel Manufacturing Category.

4.1.5.1 NPRI Analysis Overview

EPA compared water release data in TRI to data reported in Canada's NPRI for the Iron and Steel Manufacturing Category to identify the pollutants reported in NPRI, but not captured in the TRI. For those pollutants, EPA compared the reporting requirements between NPRI and TRI to understand the impact of any reporting differences (e.g., are the thresholds for reporting similar, do groups of reported chemicals include the same set of individual compounds, etc.) and further evaluated the potential for releases of these pollutants in the U.S.

For this analysis, EPA evaluated 2013 TRI and NPRI data, the most recent data available in both datasets at the time of review. EPA processed the data as described in Section 2.2 to obtain the relevant industry category, pollutant names, facility counts, and water releases for each of the datasets. For facilities associated with the Iron and Steel Manufacturing Category, EPA compared the list of pollutants with water releases reported to NPRI and TRI.

In 2013, 19 Canadian iron and steel manufacturers reported water release data for 45 pollutants to NPRI, while 215 U.S. iron and steel manufacturers reported water release data for 39 pollutants to TRI. As shown in Table 4-18, EPA identified 13 pollutants reported to NPRI that were not reported to TRI by iron and steel manufacturing facilities in 2013. Seven of the 13 pollutants are not included on the EPCRA Section 313 Chemical List for 2013 (2013 List of TRI Chemicals); therefore, facilities are not required to report releases for these pollutants (U.S. EPA, 2014b).

Table 4-18. Pollutants Reported by Iron and Steel Manufacturing Facilities to 2013 NPRI but not to 2013 TRI

Pollutant Name	On 2013 List of TRI Chemicals[a]	Number of NPRI Iron and Steel Manufacturing Facilities Reporting Pollutant Release to Water	Percentage of all NPRI Iron and Steel Manufacturing Facilities Reporting Water Release
Acenaphthene – PAH	N	1	5%
Acenaphthylene – PAH	N	2	11%
Aluminum (fume or dust)	Y	1	5%
Benzo(e)pyrene – PAH	N	1	5%
Benzo(g,h,i)perylene – PAH	Y	3	16%
Calcium fluoride	N	1	5%
Chlorine	Y[b]	1	5%
Fluorene – PAH	N	2	11%
Hydrochloric acid	Y	2	11%

Table 4-18. Pollutants Reported by Iron and Steel Manufacturing Facilities to 2013 NPRI but not to 2013 TRI

Pollutant Name	On 2013 List of TRI Chemicals[a]	Number of NPRI Iron and Steel Manufacturing Facilities Reporting Pollutant Release to Water	Percentage of all NPRI Iron and Steel Manufacturing Facilities Reporting Water Release
Perylene - PAH	N	2	11%
Phosphorus (total)	N[c]	6	32%
Pyrene - PAH	N	3	16%
Sulfuric acid	Y	2	11%

Source: *NPRICompare2013, TRILTOutput2013_v1*, (U.S. EPA, 2014b)
PAH: Polycyclic Aromatic Hydrocarbon
a Refers to pollutants included in the 2013 List of TRI Chemicals, regardless of whether water releases were reported for the pollutant.
b Chlorine is in gaseous form, and not expected to be released to water under typical conditions (U.S. EPA, 1998).
c The 2013 List of TRI Chemicals only includes Phosphorus (yellow or white). Yellow and white phosphorus, both allotropes of elemental phosphorus, are hazardous pollutants that spontaneously ignite in air. During the 2006 Annual Review, EPA identified that facilities were incorrectly reporting discharges of total phosphorus (i.e., the phosphorus portion of phosphorus-containing compounds) as phosphorus (yellow or white) (U.S. EPA, 2006). Therefore, EPA concluded that it was appropriate to exclude all phosphorus (yellow or white) discharges reported to TRI, and has made such adjustments to the data, beginning with the 2011 Annual Review (U.S. EPA, 2012). Total phosphorus (as reported in NPRI) is not included in the current List of TRI chemicals (for reporting year 2015).

4.1.5.2 NPRI Pollutant Analysis

EPA identified 13 pollutants reported to NPRI in 2013 that were not reported to TRI, over half of which are polycyclic aromatic hydrocarbons. All but phosphorus were reported to NPRI by less than 20 percent of reporting facilities. Because phosphorus was reported to NPRI by 32 percent of facilities, EPA performed a more in-depth analysis of this pollutant.

No iron and steel manufacturing facilities reported total phosphorus releases to TRI in 2013 because total phosphorus is not a TRI-listed pollutant. However, TRI does include one form of phosphorus on the 2013 List of TRI Chemicals, known as yellow or white phosphorus (U.S. EPA, 2014b). Historically, as part of its ELG planning review process, EPA excludes yellow or white phosphorus reported to TRI from its analyses because this elemental form of phosphorus is insoluble in water and is not the same form of phosphorus commonly measured in wastewater (U.S. EPA, 2012). According to NPRI reporting guidance, total phosphorus does not include yellow or white phosphorus; NPRI includes yellow or white phosphorus as a separate pollutant (Environment Canada, 2015).

EPA compared the magnitude of the phosphorous releases reported in NPRI to available 2013 DMR data for phosphorous. The 2013 NPRI total phosphorus releases ranged from 66.1 pounds to 4,880 pounds, as shown in Table 4-19. The total phosphorus discharges reported by the top ten discharging iron and steel manufacturing facilities in DMR range from 77.3 pounds to 13,100 pounds, as shown in Table 4-20. These top ten facilities account for over 99 percent of the total 2013 DMR total phosphorus discharges reported by iron and steel manufacturing facilities. In general, total phosphorus releases reported by iron and steel manufacturing facilities to NPRI in Canada are similar to the total phosphorus discharges reported by iron and steel manufacturing facilities on DMRs in the U.S., with the exception of the top two facilities reporting total phosphorus discharges on DMRs, which have much higher discharges.

Though several facilities report total phosphorus discharges on DMRs, phosphorus does not have limitations in the Iron and Steel Manufacturing ELGs. In addition, EPA has not previously reviewed total phosphorus discharges for the iron and steel manufacturing industry as part of recent ELG planning reviews. Total phosphorus does not have an associated toxic weighting factor and subsequently does not appear in EPA's TRA. See Section 2 of EPA's 2015 Annual Review Report for more information on toxic weighting factors and EPA's TRA (U.S. EPA, 2016a).

Table 4-19. Top 2013 Iron and Steel Manufacturing Facilities Reporting Total Phosphorus Releases to NPRI

Facility Name	Facility Location	Direct Pounds of Pollutant Released	Indirect Pounds of Pollutant Released	Total Pounds of Pollutant Released
Dofasco Hamilton	Hamilton, ON	1,520	3,370	4,880
Hamilton Works	Hamilton, ON	1,350	832	2,180
Gerdau Ameristeel Corporation, Whitby Mill	Whitby, ON	0	379	379
Evraz Inc NA Canada - Regina Facilities	Regina, SK	0	101	101
Sivaco Ontario	Ingersoll, ON	0	95.2	95.2
Rio Tinto Fer Et Titane Inc. Complexe De Sorel-Tracy	Sorel-Tracy, QC	66.1	0	66.1
Total		**2,930**	**4,780**	**7,710**

Source: (Environment Canada, 2014).
Note: Facilities report pounds of pollutant released directly to surface waters or indirectly to POTWs.

Table 4-20. Top 2013 Iron and Steel Manufacturing Facilities Reporting Total Phosphorus Discharges on DMRs

Facility Name	Facility Location	Pounds of Pollutant Discharged
Mittal Steel Usa Weirton Inc	Weirton, WV	13,100
Severstal Wheeling Inc – Follansbee	Follansbee, WV	12,200
U.S. Steel Corporation - Fairfield Works	Fairfield, AL	5,710
Us Steel Fairless Hills Works	Fairless Hills, PA	2,820
Nucor Steel	Crawfordsville, IN	2,060
Sterling Steel Co LLC	Sterling, IL	1,800
Standard Steel LLC	Burnham, PA	691
Crucible Industries LLC	Solvay, NY	687
USS Gary Works	Gary, IN	116
Michigan Seamless Tube LLC	South Lyon, MI	77.3
All other Iron and Steel Manufacturing dischargers of total phosphorus (three additional facilities)		70.5
Total		**39,300**

Source: *DMRLTOutput2013_v1*

4.1.6 Summary of the Iron and Steel Manufacturing Category Review

From its evaluation of lead, nitrate, copper, and manganese discharges, EPA learned:

- *Lead.* EPA identified a large number of iron and steel manufacturing facilities with reported lead discharges in the 2013 and 2014 DMR and TRI data. The Iron and Steel Manufacturing ELGs regulate lead in eight of 13 subcategories. EPA compared facility concentration data in DMR and provided by facilities reporting to TRI to concentrations achieved by the technologies evaluated in the 2002 Iron and Steel Manufacturing rulemaking. The data show that the direct discharge concentrations of lead from this category are below the concentrations achieved by the technologies evaluated for the 2002 rulemaking. Facility-specific concentration data for indirect dischargers are above most of the LTAs for lead evaluated in the 2002 rulemaking; however, they represent concentrations from facilities reporting the highest indirect releases of lead to TRI.

  Discussions with one state permitting authority indicated that the technologies for removing metals at iron and steel manufacturing facilities are well established and that they are generally removed through solids removal. EPA's review of performance data in the IWTT Database identified several technologies that effectively remove lead (not specific to iron and steel manufacturing), achieving effluent concentrations lower than the median 2014 DMR and TRI lead concentrations and generally less than, but on the same order of magnitude as the concentrations achieved by the technologies considered during the 2002 Iron and Steel Manufacturing rulemaking.

- *Nitrate.* The Iron and Steel Manufacturing ELGs do not regulate nitrate; however, EPA identified a large number of facilities with reported nitrate releases in the 2013 and 2014 TRI data. The review of facility concentration data in DMR and data provided by facilities reporting to TRI demonstrated that, in general, the nitrate direct discharge concentration values are above, but on the same order of magnitude as the concentrations achieved by most of the technologies considered in EPA's 2002 rulemaking for all but the cokemaking subcategory, BAT option, which is two orders of magnitude higher than the other subcategory LTAs. Only a few facilities report indirect releases of nitrate to TRI, and EPA was unable to obtain nitrate concentration data from these dischargers.

  EPA's review of performance data in the IWTT Database identified several technologies achieving concentrations generally of the same order of magnitude as the range of LTA nitrate concentrations identified for the 2002 rulemaking for all but the cokemaking subcategory, BAT option. In addition, several of the studies show concentrations generally of the same order of magnitude but lower than the median nitrate concentrations identified from the 2014 DMR and TRI direct discharge data

- *Copper.* The Iron and Steel Manufacturing ELGs do not regulate copper; however, EPA identified a large number of facilities with reported copper releases in the 2013 and 2014 TRI data. The review of available facility concentration data in DMR and data provided by facilities reporting to TRI demonstrated that the direct discharges of copper are below, but on the same order of magnitude as the concentrations achieved by the technologies considered during the 2002 rulemaking. The indirect discharge median concentration is above, but on the same order of magnitude as the concentrations achieved by the technologies considered during the 2002 rulemaking. However, the indirect data represent concentrations from facilities reporting the highest indirect releases of copper to TRI.

Effluent concentrations of copper from studies in IWTT are generally of the same order of magnitude as the range of the LTA copper concentrations identified for the 2002 rulemaking. Two studies achieved copper concentrations below the copper LTA range. In addition, several of the studies show concentrations below the median copper concentrations identified from the 2014 DMR and TRI direct discharge data.

- *Manganese*. The Iron and Steel Manufacturing ELGs do not regulate manganese; however, EPA identified a large number of facilities with releases in the 2013 and 2014 TRI data. During the 2002 rulemaking, EPA ultimately decided not to establish manganese limitations because manganese may be used as a treatment chemical.

  The review of facility concentration data in DMR and data provided by facilities reporting direct and/or indirect releases to TRI demonstrated that the median concentration values are above most y of the concentrations achieved by the technologies considered during the 2002 rulemaking. EPA followed up with two additional iron and steel manufacturing facilities; neither facility confirmed the source of manganese in their wastewater but suspect the discharges may result from background concentrations in the influent water. One state contact indicated that manganese is not contained in feedstock at iron and steel manufacturing facilities, but rather is a component of coal and could be a byproduct of burning coal and other substances. Of the treatment technology performance data for manganese removal in IWTT, only one study showed effluent manganese concentrations lower than the range of LTA manganese concentrations identified for the 2002 rulemaking, however, it was applied to petroleum refinery wastewater and was pilot scale. In general, manganese effluent concentrations observed from the studies in IWTT are also higher than, or the same order of magnitude as the median manganese concentrations identified from the 2014 DMR and TRI direct discharge data.

- EPA's review of NPRI identified 13 pollutants that were reported in NPRI in 2013 but not to TRI, over half of which are polycyclic aromatic hydrocarbons. EPA focused its review on total phosphorus, as it was the only pollutant reported by more than 20 percent of the iron and steel manufacturing facilities to the 2013 NPRI. TRI does not require facilities to report discharges of total phosphorus, therefore, EPA compared the magnitude of the 2013 NPRI discharges to total phosphorus discharges reported in 2013 DMR data. In general, the magnitude of total phosphorus releases in the 2013 NPRI is similar to the 2013 DMR total phosphorus loadings, with the exception of the top two discharges in the U.S., which are much higher.

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4.2 Organic Chemicals, Plastics, and Synthetic Fibers (40 CFR Part 414)

As part of the 2015 Annual Review, EPA initiated a preliminary category review of the Organic Chemicals, Plastics, and Synthetic Fibers (OCPSF) Category because it ranked high, in terms of toxic-weighted pound equivalents (TWPE), in the final 2015 toxicity rankings analysis (TRA) (U.S. EPA, 2016a). EPA previously reviewed discharges from this category as part of the 2004 through 2011, and 2013 Annual Reviews (U.S. EPA, 2004, 2005a, 2005b, 2006, 2007, 2008, 2009a, 2011a, 2012, 2014a). EPA conducted a preliminary study of carbon disulfide discharges from cellulose products manufacturers in 2011 (U.S. EPA, 2011b) and reviewed discharges from the chlorinated hydrocarbon manufacturing segment of the OCPSF Category as part of the Chlorine and Chlorinated Hydrocarbons (CCH) effluent guidelines rulemaking.[17]

From its 2015 TRA and preliminary category reviews, EPA decided that the OCPSF Category warrants further review, specifically related to the discharges of total residual chlorine and nitrate and nitrate compounds (nitrate) (U.S. EPA, 2016b). The OCPSF Category effluent limitations guidelines and standards (ELGs) do not regulate either of these pollutants. As part of this review, EPA further evaluated the discharges of these pollutants to:

- Understand the process operations at OCPSF facilities that generate the pollutants and how the facilities are currently managing their wastewater.
- Understand how permitting authorities currently regulate discharges of these pollutants.
- Decide if the concentrations of total residual chlorine or nitrate in effluent discharges are present at a level that could be reduced by further treatment.
- Identify advances in industrial wastewater treatment technology performance for reducing discharges of the pollutants.
- Identify additional pollutants potentially present in facility industrial wastewater discharges in the U.S., not currently captured in discharge monitoring report (DMR) data or Toxics Release Inventory (TRI) data.

Section 4.2.1 provides a background of the OCPSF Category (40 CFR Part 414), and Section 4.2.2 provides a summary of the results of the previous ELG planning review related to the OCPSF Category. Sections 4.2.3 through 4.2.6 present EPA's current review approach and evaluation of the OCPSF Category, including results from EPA's continued review of the top pollutants in the category, evaluation of available treatment technology performance, and the results of the additional pollutant analysis. Section 4.2.7 summarizes EPA's current review of the OCPSF Category.

4.2.1 OCPSF Category Background

The OCPSF Category includes more than 1,000 chemical manufacturing facilities (identified in 1987 as part of the rulemaking for this category), producing over 25,000 end products, such as benzene, toluene, polypropylene, polyvinyl chloride, chlorinated solvents, rubber precursors, rayon, nylon, and polyester. The OCPSF industry is large and diverse, and

[17] Based on the information collected during the rulemaking, EPA proposed to delist the CCH manufacturing segments and discontinue the rulemaking in 2012.

many plants are highly complex. Some plants produce chemicals in large volumes through continuous chemical processes, while others produce only small volumes of specialty chemicals through batch chemical processes (U.S. EPA, 2016c). The following subsections present an overview of the OCPSF Category ELGs and their applicability.

4.2.1.1 OCPSF ELGs

EPA promulgated ELGs for the OCPSF Category on November 5, 1987. The OCPSF Category consists of seven subcategories defined by the manufacture of different products, and three subcategories based on the type of facility discharge, as shown in Table 4-21, with corresponding basis for applicability.

Table 4-21. OCPSF ELGs Subcategories

Subpart	Subcategory Title	Basis for ELG Applicability
B	Rayon Fibers	Cellulosic manmade fiber (Rayon) manufactured by the Viscose process.
C	Other Fibers	All other synthetic fibers (except Rayon) including, but not limited to, products listed in Section 414.30.
D	Thermoplastic Resins	Any plastic product classified as a thermoplastic resin including, but not limited to, products listed in Section 414.40.
E	Thermosettting Resins	Any plastic product classified as a thermosetting resin including, but not limited to, products listed in Section 414.50.
F	Commodity Organic Chemicals	Commodity organic chemicals and commodity organic chemical groups including, but not limited to, products listed in Section 414.60.
G	Bulk Organic Chemicals	Bulk organic chemicals and bulk organic chemical groups including, but not limited to, products listed in Section 414.70.
H	Specialty Organic Chemicals	All other organic chemicals and organic chemical groups including, but not limited to, products listed in the OCPSF Development Document (Vol. II, Appendix II-A, Table VII).
I	Direct Discharge Point Sources That Use End-of-Pipe-Biological Treatment	Process wastewater discharges resulting from the manufacture of the OCPSF products and product groups from any point source that uses end-of-pipe biological treatment or installs end-of-pipe biological treatment to comply with BPT effluent limitations.
J	Direct Discharge Point Sources That Do Not Use End-of-Pipe-Biological Treatment	Process wastewater discharges resulting from the manufacture of the OCPSF products and product groups from any point source that does not use end-of-pipe biological treatment and does not install end-of-pipe biological treatment to comply with Best Practicable Control Technology Currently Available (BPT) effluent limitations.
K	Indirect Discharge Point Sources	Process wastewater discharges resulting from the manufacture of the OCPSF products and product groups from any indirect discharge point source.

Source: (U.S. EPA, 2005b).

4.2.1.2 OCPSF Category Applicability

The OCPSF regulation applies to process wastewater discharges resulting from the manufacture of the products or product groups covered in subparts B through H. For the purpose of its annual reviews, EPA considers the following 14 North American Industry Classification System (NAICS) codes and 10 Standard Industrial Classification (SIC) codes to be part of the OCPSF Category, identified from the NAICS-Point Source Category (NAICS-PSC) and SIC-

PSC crosswalks developed for the 304m Annual Review process (U.S. EPA, 2009b). The 14 NAICS codes are:

- NAICS 325110: Petrochemical Manufacturing
- NAICS 325132: Synthetic Organic Dye and Pigment Manufacturing
- NAICS 325192: Cyclic Crude and Intermediate Manufacturing
- NAICS 325193: Ethyl Alcohol Manufacturing
- NAICS 325199: All Other Basic Organic Chemical Manufacturing
- NAICS 325211: Plastics Material and Resin Manufacturing
- NAICS 325221: Cellulosic Organic Fiber Manufacturing
- NAICS 325222: Noncellulosic Organic Fiber Manufacturing
- NAICS 325520: Adhesive Manufacturing
- NAICS 325612: Polish and Other Sanitation Good Manufacturing
- NAICS 325620: Toilet Preparation Manufacturing
- NAICS 325998: All Other Miscellaneous Chemical Product and Preparation Manufacturing
- NAICS 424690: Other Chemical and Allied Products Merchant Wholesalers
- NAICS 562920: Materials Recovery Facilities

The ten SIC codes include:

- SIC 2821: Plastics Materials, Synthetic and Resins, and Nonvulcanizable Elastomers
- SIC 2823: Cellulosic Man-Made Fibers
- SIC 2824: Manmade Organic Fibers, Except Cellulosic
- SIC 2842: Specialty Cleaning, Polishing, and Sanitation Preparation
- SIC 2844: Perfumes, Cosmetics, and Other Toilet Preparations (except toothpaste, gel, and dentifrice powders)
- SIC 2865: Cyclic Crudes and Intermediates, Dyes, and Organic Pigments
- SIC 2869: Industrial Organic Chemicals, NEC (cyclopropane, diethylcyclohexane, naphthalene sulfonic acid)
- SIC 2891: Adhesives and Sealants
- SIC 2899: Chemicals and Chemical Preparations, NEC (table salt)
- SIC 5169: Chemicals and Allied Products, NEC (merchant wholesalers)

Additionally, wastewater generated by facilities in the following NAICS codes may be regulated under multiple categories, including OCPSF.[18]

- NAICS 311999: All Other Miscellaneous Food Manufacturing
- NAICS 324199: All Other Petroleum and Coal Products Manufacturing

[18] As part of the 2010 Annual Review, EPA reviewed available information about pollutant loads and manufacturing operations at facilities reporting these NAICS codes and concluded that the OCPSF ELGs apply to some of the facilities in these NAICS codes (U.S. EPA, 2011b).

- NAICS 325120: Industrial Gas Manufacturing
- NAICS 325188: All Other Basic Inorganic Chemical Manufacturing
- NAICS 325510: Paint and Coating Manufacturing
- NAICS 325611: Soap and Other Detergent Manufacturing
- NAICS 326199: All Other Plastics Product Manufacturing
- NAICS 339999: All Other Miscellaneous Manufacturing

The OCPSF ELGs applied to approximately 1,000 facilities at the time of promulgation in 1987. Approximately 320 of the 1,000 facilities discharged to surface waters, while approximately 420 facilities discharged to publicly owned treatment works (POTWs). EPA identified the remaining facilities as either zero dischargers, alternative dischargers, or discharge status unknown (U.S. EPA, 1987).

EPA identified 649 OCPSF facilities reporting water releases to TRI in 2014, with 201 facilities reporting direct releases to surface waters, 391 facilities reporting indirect releases to POTWs, and 57 facilities reporting both direct and indirect releases (*TRILTOutput2014_v1*). EPA identified 273 OCPSF facilities that submitted 2014 DMR data to the Integrated Compliance Information System for the National Pollutant Discharge Elimination System (ICIS-NPDES) (*DMRLTOutput2014_v1*). While these numbers appear to show a decline in the number of OCPSF facilities discharging since the 1980s, due to the limitations of the DMR and TRI datasets, EPA does not have an exact count of how many facilities currently are subject to the OCPSF ELGs. See Section 2.1 for a discussion on the limitations of DMR and TRI data.

4.2.2 Summary of the Results of the 2015 Annual Review for the OCPSF Category

During the 2015 Annual Review, EPA identified DMR discharges of total residual chlorine and TRI releases of nitrate for further review. The paragraphs below summarize the results of EPA's previous review regarding these two pollutants (U.S. EPA, 2016b).

- *Total residual chlorine.* In 2013, 97 facilities reported total residual chlorine discharges, out of a total of 280 OCPSF facilities reporting 2013 DMR data. Four facilities account for over 60 percent of those discharges. EPA reviewed the DMR data for these four facilities and all four met their permit limits in 2013; however, the total residual chlorine limit for three of the facilities was a minimum total residual chlorine concentration limit. EPA did not conduct a facility-level review of the total residual chlorine discharges for the remaining 93 facilities because no single facility contributed more than 5,000 TWPE. However, due to the number of facilities with total residual chlorine discharges in the 2013 DMR data, and an indication that three of the top four facilities reporting total residual chlorine discharges only have minimum total residual chlorine limits in their permits, EPA concluded that further investigation of this pollutant is appropriate to evaluate whether discharges are industry-wide and present at a level substantial enough for further treatment.
- *Nitrate.* In 2013, 121 facilities reported releases of nitrate to TRI out of a total of 651 OCPSF facilities reporting 2013 TRI releases; two facilities account for 38 percent of those releases. EPA confirmed that both facilities base their nitrate TRI releases on monitoring data. One facility's nitrate releases have remained similar from 2010

through 2013, while the other facility's nitrate releases have decreased from 2010 through 2013. EPA did not conduct a facility-level review of the remaining 119 facilities reporting TRI nitrate releases in 2013. However, due to the number of facilities with nitrate releases in the TRI data, EPA concluded that further investigation of nitrate is appropriate to evaluate whether discharges are industry-wide and present at a level substantial enough for further treatment.

4.2.3 Introduction to EPA's Current Evaluation of Specific Pollutants in the OCPSF Category

For the current review, EPA evaluated the discharges of total residual chlorine and nitrate to satisfy the objectives outlined above in Section 4.2. The OCPSF ELGs do not regulate either of these pollutants. Specifically, EPA:

- Evaluated available 2014 DMR and TRI data[19] for the two pollutants, including concentration data reported on DMRs.
- Contacted several OCPSF facilities reporting nitrate releases to TRI to gather underlying discharge concentrations that formed the basis for releases reported to TRI as well as information on process operations contributing to those releases and wastewater treatment technologies employed.[20]
- Contacted state permitting authorities to further understand the development of pollutant permit limits and current processes for managing wastewater containing these pollutants.
- Researched the performance of available treatment technologies in the Industrial Wastewater Treatment Technology (IWTT) Database for nitrate.
- Reviewed available data in Canada's National Pollutant Release Inventory (NPRI) to identify any additional pollutants that may be present in OCPSF wastewater discharges that are not reported in the U.S. under the TRI or DMR programs.

Table 4-22 compares the 2013 and 2014 TRI and DMR TWPE and the number of facilities reporting discharges of the two pollutants. Section 4.2.4 presents EPA's analyses and results related to total residual chlorine. Section 4.2.5 presents EPA's analyses and results related to nitrate. Section 4.2.6 presents EPA's analysis of the NPRI data.

[19] EPA evaluated 2014 data because it represented the most current and complete DMR and TRI dataset available at the start of the current review. Note that EPA evaluated 2013 DMR and TRI data in support of the 2015 Annual Review.

[20] Chlorine is a TRI listed chemical, however, the reported chlorine constituent is a gaseous form of the chemical, which EPA has concluded does not lead to water releases under normal circumstances. Therefore, EPA excludes water releases of chlorine reported to TRI from the Water Pollutant Loading Tool. The TRI program does not include total residual chlorine in its list of reported chemicals (U.S. EPA, 2014c). As a result, EPA limited its review to total residual chlorine data reported on 2014 DMRs.

Table 4-22. 2013 and 2014 DMR and TRI TWPE and Number of OCPSF Facilities Discharging Total Residual Chlorine and Nitrate

Pollutant	2014 TRI Data		2013 TRI Data		2014 DMR Data		2013 DMR Data	
	Number of Facilities [a]	TWPE	Number of Facilities [a]	TWPE	Number of Facilities [a]	TWPE	Number of Facilities [a]	TWPE
Total Residual Chlorine	NR	NR	NR	NR	102	101,000[b]	97	49,200
Nitrate	120	14,000	121	13,200	14	337	16	329
Total for All Pollutants Reported	**649**	**379,000[c]**	**651**	**286,000[d]**	**271**	**314,000[c]**	**280**	**224,000[d]**

Sources: *TRILTOutput2014_v1*; *TRILTOutput2013_v1*; *DMRLTOutput2014_v1*; *DMRLTOutput2013_v1*.
Note: Sums of individual values may not equal the total presented, due to rounding.
NR: not reported.
[a] Number of OCPSF facilities with TWPE greater than zero.
[b] The 2014 total residual chlorine DMR TWPE includes corrected data for the top discharging facility carried over from the 2015 Annual Review (U.S. EPA, 2016a).
[c] EPA did not complete a comprehensive quality review of the remainder of the 2014 TRI and DMR data; therefore, this total may include outliers. See Section 2.1 for more information.
[d] Total includes corrected data as identified during the 2015 Annual Review (U.S. EPA, 2016a).

4.2.4 OCPSF Category Review of Total Residual Chlorine Discharges

As described in Section 4.2.2, from the 2015 Annual Review, EPA identified 97 facilities with total residual chlorine discharges in the 2013 DMR data, and an indication that three of the top four facilities reporting total residual chlorine discharges only have minimum total residual chlorine limits in their permits. Therefore, EPA concluded that further investigation of this pollutant is appropriate to decide whether discharges are industry-wide and present at a level substantial enough for further treatment. Total residual chlorine does not have limitations under the OCPSF ELGs and was not identified as a pollutant of concern during the development of the ELGs. Additionally, EPA has not conducted a detailed review of total residual chlorine discharges as part of recent annual reviews or studies of the industry, outside of the preliminary review conducted as part of the 2015 Annual Review.

For the current review, EPA focused its evaluation on effluent concentrations of total residual chlorine. As shown in Table 4-22, 102 facilities reported releases of total residual chlorine on 2014 DMRs.

To understand the magnitude and potential hazard of the discharges, EPA obtained available average total residual chlorine concentration data for 71 OCPSF facilities from 2014 DMRs, following the methodology outlined in Section 2.1.4. [21] EPA compiled and compared these data to the national recommended aquatic life water quality criteria for receiving water bodies for chlorine (maximum concentration of 19 micrograms per liter (µg/L) and continuous

[21] EPA reviewed total residual chlorine concentration data for OCPSF facilities that report monthly average concentration values in the 2014 DMR data; not all facilities with total residual chlorine loads report monthly average concentration data. Additionally, the concentration data includes facilities with permit limits as well as monitoring requirements for total residual chlorine.

concentration of 11 μg/L) (ERG, 2016; U.S. EPA, 2016d). The combination of a maximum concentration and a continuous concentration provide an appropriate degree of protection to aquatic organisms and their uses in receiving waters and protect from acute and chronic toxicity to animals, toxicity to plants, and bioaccumulation by aquatic organisms. The criteria consider factors such as species growth, reproduction, and survival along with quality of the receiving water (hardness, pH, salinity etc.). DMR data reflect facility effluent measurements, typically at the end of the discharge pipe (U.S. EPA, 1985). Therefore, although the comparison of aquatic life water quality criteria to effluent measurements does not determine if water quality criteria in these facilities' receiving waters are being violated (since flow, dilution, frequency and duration are not possible to evaluate), this comparison does provide a frame of reference for better understanding the magnitude of the total residual chlorine discharges and their potential for posing a hazard.

Table 4-23 compares the minimum, median, and maximum 2014 average total residual chlorine concentration data for OCPSF facilities to the maximum and continuous national recommended aquatic life water quality criteria for chlorine.

Table 4-23. Comparison of OCPSF Facility 2014 Average Total Residual Chlorine Concentration Data to Water Quality Criteria

	Number of Data Points [a]	Average Total Residual Chlorine Concentration		
		Minimum (mg/L)	Median (mg/L)	Maximum (mg/L)
2014 OCPSF Facility DMR Data	82	0.00002	0.018	1.23
Maximum Concentration Chlorine Aquatic Life Water Quality Criterion	0.019 mg/L			
Continuous Concentration Chlorine Aquatic Life Water Quality Criterion	0.011 mg/L			

Source: *DMRLTConcOutput2014_v1,* (U.S. EPA, 2016d).
[a] The number of data points is by outfall, not by facility. Some facilities have more than one outfall.

As shown, the median total residual chlorine concentration from OCPSF facilities falls just below the maximum (acute) concentration aquatic life water quality criterion (0.019 mg/L) for chlorine, but slightly above the continuous (chronic) concentration aquatic life water quality criterion (0.011 mg/L).

To further understand the sources, potential impact, and treatment or control of total residual chlorine discharges, EPA contacted several states that have OCPSF facilities with total residual chlorine permit limits, presented in Section 4.2.4.1.

4.2.4.1 Summary of Permit Reviews and Information Provided by States Regarding Discharges of Total Residual Chlorine

EPA contacted four state permitting authorities to discuss total residual chorine discharges: the Iowa Department of Natural Resources (IA DNR), Nebraska Department of Environmental Quality (NE DEQ), West Virginia Department of Environmental Protection (WV DEP), and the Texas Commission on Environmental Quality (TCEQ). EPA's purpose was to understand how permit limits or other requirements are established, what processes or operations at OCPSF facilities lead to total residual chlorine discharges, and how discharges are treated. Table 4-24 presents the number of OCPSF facilities in each state with 2014 DMR total residual chorine loads greater than zero. EPA prioritized the four states to contact based on the number of facilities with 2014 DMR total residual chlorine discharges. In selecting these states, EPA also considered the stringency of total residual chlorine permit limits. EPA summarizes its discussions and the information obtained from each state below.

Table 4-24. OCPSF Facility Total Residual Chorine 2014 DMR Discharges by State

State Name	Count of Facilities with Loads Greater than Zero
Iowa	24
Texas	17
Nebraska	10
West Virginia	9
Indiana	8
Illinois	7
Louisiana	5
New York	4
Tennessee	3
South Carolina	3
Connecticut	3
Virginia	3
South Dakota	2
Massachusetts	1
Utah	1
Florida	1
Pennsylvania	1
Total	102

Source: *DMRLTOutput2014_v1*

Iowa

EPA contacted the IA DNR to discuss permitting practices for total residual chlorine and to obtain the permits for four OCPSF facilities accounting for the majority of 2014 DMR total residual chlorine discharges in Iowa. The state contact also provided information on five additional OCPSF facilities in the state.[22]

Based on a review of the permits for the top discharging facilities and discussions with IA DNR, the state typically calculates total residual chlorine limits using water-quality-based effluent limits (WQBELs) and Wasteload Allocations (WLA). IA DNR develops a WLA for each facility that may discharge treated or untreated wastewater into state waters to assure that the permitted effluent limits meet applicable state water quality standards. IA DNR defines a WLA as the portion of a receiving water's total assimilative capacity that is allocated to one of its existing or future point sources of pollution. IA DNR bases the calculation of the WLA on conservative assumptions to protect water quality under worst-case scenarios. Total residual chlorine WLAs are typically calculated using mass balance calculations, taking into account mixing zones and decay within pipes or in holding tanks (Hieb, 2016). IA DNR uses the total

[22] Two of the five facilities for which the state provided information do not have total residual chlorine limits. EPA did not include these facilities in this review.

residual chlorine WLA calculated for a facility discharge and information on the source of total residual chlorine at the facility (use chlorine to treat municipal water, addition of chlorine in its processes or wastewater treatment, etc.) before deciding to add a total residual chlorine permit limit.

From review of facility permits, waste streams associated with total residual chlorine limits contain cooling water, boiler blowdown, and/or reverse osmosis (RO) reject (or a concentrated stream). Additionally, facilities may be adding chlorine to the wastewater treatment process in the form of sodium hypochlorite to control biological growth. The state contact stated that facilities may use a chemical feed of sodium bisulfate to help treat total residual chlorine (Hieb, 2016). Table 4-26 below provides a summary of the permit information for the seven facilities identified.

Nebraska

EPA contacted the NE DEQ to discuss permitting practices for total residual chlorine and to obtain permits for four OCPSF facilities accounting for the majority of 2014 DMR total residual chlorine discharges in Nebraska. According to the state contact the state uses WQBELs to calculate water quality limits for individual facilities. These calculations consider mixing zones. The state focuses on limits for total residual chlorine but will sometimes look at total available chlorine limits for internal outfalls only (Anderson, 2016).

Most of the OCPSF facilities in Nebraska are ethanol plants that may have total residual chlorine limits due to cooling tower blowdown where chlorine is used as a biocide. According to the state contact, the facilities typically treat the chlorine with a sodium bisulfite decholorination system (Anderson, 2016). From review of facility permits, waste streams associated with total residual chlorine limits contain cooling water, boiler blowdown, and/or RO reject (or a concentrated stream). Table 4-26 below provides a summary of the permit information for the four facilities identified.

West Virginia

EPA contacted WV DEP to discuss permitting practices for total residual chlorine and to obtain permits for four OCPSF facilities accounting for the majority of 2014 DMR total residual chlorine discharges in West Virginia. If the facility reports total residual chlorine discharges in the data submitted with their permit application, the state uses the WQBELs along with facility-specific information to determine a permit limit. The state also considers mixing zones and dilution factors when determining a permit limit. The state contact said that total residual chlorine limits are more commonly seen for OCPSF facilities compared to other industries because dechlorination systems are common (Lockhart, 2016). Table 4-26 below provides a summary of the permit information for the four facilities identified.

Texas

In reviewing 2014 DMR data for total residual chlorine, EPA identified several facilities in Texas that reported minimum total residual chlorine concentrations on their DMRs instead of, or in addition to, either average or maximum concentrations.[23] As outlined in Section 2.1.4, EPA obtained facility minimum total residual chlorine effluent concentrations from DMRs for each outfall, by reporting period (e.g., monthly, quarterly). EPA averaged the concentrations for each reporting period to calculate an annual average of the minimum total residual chlorine concentrations reported per outfall. Table 4-25 presents the minimum, median, and maximum of the 2014 averaged minimum total residual chlorine concentrations reported by OCPSF facilities with minimum permit limits. All facilities with minimum permit limits are all located in Texas.

Table 4-25. Summary of OCPSF Facility Minimum Total Residual Chlorine 2014 Concentration Data

	Number of Data Points [a]	Minimum Total Residual Chlorine Concentration		
		Minimum (mg/L)	Median (mg/L)	Maximum (mg/L)
OCPSF Facility DMR Data	17	0.54	1.94	192.7

Source: *DMRLTConcOutput2014_v1*
[a] The number of data points is by outfall, not by facility. Some facilities have more than one outfall.

EPA contacted TCEQ to understand the circumstances under which a facility would report a minimum total residual chlorine concentration, to discuss permitting practices for total residual chlorine, and to obtain permits for the five OCPSF facilities accounting for the majority of 2014 DMR total residual chlorine discharges in Texas. From its review of the 2014 DMR data, EPA identified that four of the five OCPSF facilities with the highest total residual chlorine discharges in Texas have minimum total residual chlorine permit limits, as opposed to average or maximum limits.

The state contact stated that the minimum limits for total residual chlorine are applied in a draft permit when the discharge from an OCPSF facility contains sanitary wastewater or demonstrates a reasonable potential for process-based bacteria to be discharged. In these instances, the TCEQ follows the guidelines of 30 TAC §309.3(g)(2)[24] when applying total residual chlorine limits in a discharge permit for an OCPSF facility (Gibson, 2016).

The Texas Administrative Code 309.3(g)(2) establishes requirements for disinfection of facility effluent and states: "Where chlorination is utilized, any combination of detention time and chlorine residual where the product of chlorine (Cl_2 mg/l) X Time (T minutes) equals or exceeds 20 is satisfactory provided that the minimum detention time is at least 20 minutes and the minimum residual is at least 0.5 mg/L. The maximum chlorine residual in any discharge shall in no event be greater than four mg/l per grab sample, or that necessary to protect aquatic life."

The state contact indicated that it is very common for industrial facilities, including OCPSF facilities, to treat sanitary wastewater onsite, rather than route it to a POTW. Table 4-26 below provides a summary of the permit information for the five Texas facilities identified. All

[23] Facilities may submit minimum, average, and/or maximum concentration measurements on their DMRs, depending on the type of limits in a permit, per reporting period (e.g., monthly, quarterly).

[24] Available in the Texas Administrative Code.

permits reviewed for OCPSF facilities in Texas indicate that the facilities are mixing sanitary wastewater with process wastewater.

Summary of Permit Reviews for Total Residual Chlorine

EPA reviewed 20 OCPSF facility permits, in total, across four states. Table 4-26 summarizes the information obtained from these permit reviews. As shown in the table, seven of the 20 facilities with total residual chlorine permit limits and/or monitoring requirements are involved in corn milling and/or ethanol production.

From discussions with states and review of facility permits, EPA concluded that Iowa, Nebraska, and West Virginia calculate total residual chlorine permit limits based on WQBELs, that consider mixing zones and dilution factors. EPA also concluded that total residual chlorine discharges do not likely result from OCPSF process wastewater; a majority of the waste streams with associated total residual chlorine limits across all of the states include cooling water, boiler blowdown, and/or RO reject (or concentrated stream), which may be commingled with process wastewater. In many instances, facilities may be adding chlorine to waste streams that are not considered process waste streams to control undesirable biological growth. As shown in Iowa and Nebraska, industrial facilities may have process controls in place to address total residual chlorine discharges, such as dechlorination systems.

In addition, total residual chlorine discharges may result from OCPSF facilities treating sanitary wastewater, which is commingled with process wastewater. Two West Virginia facility permits indicate that facilities in this state can commingle sanitary wastewater with process wastewater; however, the associated outfalls have daily maximum and monthly average permit limits for total residual chlorine. The state of Texas also allows OCPSF facilities to commingle sanitary wastewater with process wastewater. In these instances, the state will establish minimum total residual chlorine permit limits for the purpose of disinfection of the effluent.

Table 4-26. Summary of Permit Information for OCPSF Facilities Discharging Total Residual Chlorine

NPDES ID	Facility Name	Facility Location	SIC Code	Description	Outfall	Monthly Average TRC Limit	Daily Maximum TRC Limit	Outfall Waste-streams	Notes
IA0081043	Southwest Iowa Renewable Energy	Council Bluffs, IA	2869: Industrial Organic Chemicals NEC	Fuel grade ethanol production from corn, using the dry-mill process.	001	2.233 mg/L, 6.163 lb/day	2.233 mg/L, 6.163 lb/day	Noncontact cooling water, softener regeneration, RO reject, and sand filter backwash (no process water is discharged).	Facility chlorinates after clarification and dechlorinates prior to reverse osmosis.
IA0082279	ADM Bioprocessing[a]	Clinton, IA	2079: Edible Fats & Oils; 2899: Chemical Preparations NEC	Biological fermentation using dextrose feedstock.	001	1.067 mg/L, 3.363 lb/day	1.067 mg/L, 3.363 lb/day	Noncontact cooling water blowdown (no process water is discharged).	Facility uses municipal water for cooling and adds sodium hypochlorite to the cooling tower water.
IA0079456	The Andersons Denison Ethanol[b]	Denison, IA	2869: Industrial Organic Chemicals NEC	Ethanol production facility using the dry-mill process.	001	0.355 mg/L, 0.451 lb/day	0.355 mg/L, 0.451 lb/day	Noncontact cooling water, softener regeneration, RO reject, and sand filter backwash (no process water is discharged).	Facility adds sodium hypochlorite to control biological growth. Dechlorination provided by sodium bisulfite.
IA0081248	Plymouth Energy LLC	Merrill, IA	2869: Industrial Organic Chemicals NEC	Ethanol production facility using the dry-mill process.	001	0.311 mg/L, 0.834 lb/day	0.319 mg/L, 0.856 lb/day	Cooling tower blowdown, boiler blowdown, RO reject, water softener regeneration and filter backwash.	Facility chlorinates and dechlorinates.

Table 4-26. Summary of Permit Information for OCPSF Facilities Discharging Total Residual Chlorine

NPDES ID	Facility Name	Facility Location	SIC Code	Description	Outfall	Monthly Average TRC Limit	Daily Maximum TRC Limit	Outfall Waste-streams	Notes
IA0000205	Monsanto Company[c]	Muscatine, IA	2869: Industrial Organic Chemicals	Organic chemical and plastics material & resin manufacturing.	001	0.663 mg/L, 26.462 lb/day	0.663 mg/L, 26.462 lb/day	Total plant discharge to the Mississippi River.	No additional information on total residual chlorine discharges provided.
IA0000256	Roquette America, Inc.[c]	Keokuk, IA	2046: Wet Corn Milling	Not provided.	001	0.393 mg/L, 0.638 lb/day	0.393 mg/L, 0.638 lb/day	Boiler blowdown.	Load limits effective 11/09/12 to 11/08/17. Concentration limits effective 01/01/15 to 11/08/17.
					009	0.393 mg/L, 103 lb/day	0.393 mg/L, 103 lb/day	RO reject, boiler blowdown, cooling tower blowdown, etc.	Load and concentration limits effective 1/1/15 to 11/8/17.
					011	0.393 mg/L, 17 lb/day	0.393 mg/L, 17 lb/day	Cooling tower blowdown, surface runoff, heat exchanger drain drainage, etc.	
					012	0393 mg/L, 14 lb/day	0393 mg/L, 14 lb/day	Wastewater from corn wet milling operations.	

Table 4-26. Summary of Permit Information for OCPSF Facilities Discharging Total Residual Chlorine

NPDES ID	Facility Name	Facility Location	SIC Code	Description	Outfall	Monthly Average TRC Limit	Daily Maximum TRC Limit	Outfall Waste-streams	Notes
IA0052535	New Haven Chemicals Iowa, LLC.	Manly, IA	2865: Cyclic Organic Crudes; 2869: Industrial Organic Chemicals NEC	Sodium methylate manufacturing.	003	0.274 mg/L, 0.180 lb/day	0.332 mg/L, 0.219 lb/day	Treated process wastewater, laboratory wastewater, contaminated tank farm runoff, boiler blowdown, cooling tower blowdown, RO reject, & filter backwash.	Facility is a new discharger as of January 2016. The facility is using bleach as a cooling tower additive, therefore, a TRC limit was included in the permit.
NE0131334	Cargill Corn Milling [d]	Blair, NE	2046: Wet Corn Milling; 2869: Industrial Organic Chemicals; 2821: Plastics Materials & Resins	Corn milling & ethanol production.	001	Monitoring only	Monitoring only	Discharge from Cargill's privately owned WWTP.	The WWTP treats process and non-process wastewater from corn milling and ethanol production facilities as well as process wastewater from other plants within the complex. Includes noncontact cooling tower blowdown.
					002	0.011 mg/L, 0.014 kg/d	0.019 mg/L, 0.027 kg/d	Noncontact cooling tower blowdown.	Cooling tower blowdown from the Cargill corn milling facility.

Table 4-26. Summary of Permit Information for OCPSF Facilities Discharging Total Residual Chlorine

NPDES ID	Facility Name	Facility Location	SIC Code	Description	Outfall	Monthly Average TRC Limit	Daily Maximum TRC Limit	Outfall Waste-streams	Notes
					003	0.011 mg/L, 0.002 kg/d	0.019 mg/L, 0.004 kg/d	Noncontact cooling water blowdown.	Cooling tower blowdown from the Germ facility (another facility onsite).
NE0134279	Cornhusker Energy Lexington, LLC. [e]	Lexington, NE	2869: Industrial Organic Chemicals	Fuel-grade ethanol production.	001	3/1-5/31: 0.01 mg/L, 0.02 kg/d	3/1-5/31: 0.02 mg/L, 0.03 kg/d 6/1-10/31: 0.02 mg/L, 0.04 kg/d 11/1-2/28: 0.02 mg/L, 0.03 kg/d	Noncontact cooling water.	Facility has seasonal daily maximum total residual chlorine limits.[f]
NE0137715	Green Plains Wood River	Wood River, NE	2869: Industrial Organic Chemicals	Fuel-grade ethanol production.	001	0.010 mg/L	0.020 mg/L	Non-process wastewater including cooling tower blowdown, RO reject, filter backwash, etc.	No additional information on total residual chlorine discharges provided.
NE0138045	Bridgeport Ethanol LLC.	Bridgeport, NE	2869: Industrial Organic Chemicals	Dry grain milling ethanol plant.	001	3/1-5/31: 0.18 mg/L, 0.11 kg/d 6/1-10/31: 0.14 mg/L, 0.08 kg/d 11/1-2/28: 0.73 mg/L, 0.42 kg/d	3/1-5/31: 0.37 mg/L, 0.22 kg/d 6/1-10/31: 0.28 mg/L, 0.16 kg/d 11/1-2/28: 1.46 mg/L, 0.85 kg/d	Non-process wastewater including cooling water and utility wastewaters.	Facility has seasonal total residual chlorine limits.[f]

Table 4-26. Summary of Permit Information for OCPSF Facilities Discharging Total Residual Chlorine

NPDES ID	Facility Name	Facility Location	SIC Code	Description	Outfall	Monthly Average TRC Limit	Daily Maximum TRC Limit	Outfall Waste-streams	Notes
WV0005169	Bayer Material Science	New Martinsville, WV	2821: Plastics Materials, 2865: Cyclic Organic Crudes, 2869: Industrial Organic Chemicals;	Plastics & Organic Chemical Manufacturing .	001	294 µg/L	589 µg/L	Cooling water, stormwater runoff, process water, other.	No additional information on total residual chlorine discharges provided.
WV0000787	Cytec Industries Inc.	Belmont, WV	2869: Industrial Organic Chemicals; 2899: Chemical Preparations	Organic Chemical Manufacturing .	001	11/1/15-10/31/17: Monitoring only	11/1/15-10/31/17: Monitoring only	Cooling water, stormwater runoff, process water, other.	Interim limits [g]
					001	11/1/17 – 6/30/19: 28 µg/L	11/1/17 – 6/30/19: 57 µg/L		Final limits
					008	11/1/17 – 6/30/19: 6.1 µg/L	11/1/17 – 6/30/19: 9.7 µg/L	Sanitary wastewater, cooling water, stormwater runoff.	Final limits
WV0000841	Sabic Innovative Plastics US LLC.	Washington, WV	2822: Synthetic Rubber; 2821: Plastics Materials	Manufacturing of ABS (acrylonitrile, butadiene, styrene) polymers.	001	28 µg/L	57 µg/L	Sanitary wastewater, stormwater runoff, process water, other.	Facility wastewater treatment includes neutralization system, primary clarification, rotary screen, flow equalization,
					002	Monitoring only	Monitoring only	Cooling water, stormwater runoff, other.	

Table 4-26. Summary of Permit Information for OCPSF Facilities Discharging Total Residual Chlorine

NPDES ID	Facility Name	Facility Location	SIC Code	Description	Outfall	Monthly Average TRC Limit	Daily Maximum TRC Limit	Outfall Waste-streams	Notes
					006	Monitoring only	Monitoring only	Cooling water, stormwater runoff, other.	aeration, secondary clarification, disinfection, and tertiary filters.
WV0116416	Kureha PGA, LLC	Belle, WV	Not provided.	Not provided.	001	Monitoring only [h]	Monitoring only [h]	Cooling water, stormwater runoff.	No additional information on total residual chlorine discharges provided.
TX0006017	Oxea Bay City Plant	Bay City, TX	2869: Industrial Organic Chemicals	Organic chemical manufacturing.	001	1.0 mg/L (minimum limit after a detention time of at least 20 minutes)[i]		Treated sanitary wastewater, process wastewater, stormwater, groundwater from monitoring wells.	No additional information on total residual chlorine discharges provided.
TX0003531	Equistar Chemicals Channelview Complex	Houston, TX	2869: Industrial Organic Chemicals	Synthetic organic chemical manufacturing.	001	1.0 mg/L (minimum limit after a detention time of at least 20 minutes)[i]		Treated process wastewater, auto shop wastewater, laboratory wastewater, sanitary wastewater, cooling tower blowdown.	No additional information on total residual chlorine discharges provided.

Table 4-26. Summary of Permit Information for OCPSF Facilities Discharging Total Residual Chlorine

NPDES ID	Facility Name	Facility Location	SIC Code	Description	Outfall	Monthly Average TRC Limit	Daily Maximum TRC Limit	Outfall Waste-streams	Notes
TX0005061	Goodyear Tire & Rubber Co.	Beaumont, TX	2821: Plastics Materials, 2822: Synthetic Rubber; 2869: Industrial Organic Chemicals	Synthetic rubber, adhesive resins, antioxidants & isoprene manufacturing.	001	1.0 mg/L (minimum limit after a detention time of at least 20 minutes)[i]		Treated process wastewater, utility wastewater, sanitary wastewater, process area stormwater.	No additional information on total residual chlorine discharges provided.
TX0006084	Rohmax USA	Deer Park, TX	2869: Industrial Organic Chemicals; 2819: Industrial Inorganic Chemicals, NEC	Chemical manufacturing facility.	001	Monitoring only	Monitoring only	Treated process wastewater, stormwater, utility wastewater, sanitary wastewater.	No additional information on total residual chlorine discharges provided.
					009	Monitoring only	Monitoring only		
					010	21.4 lb/day	36.0 lb/day	Reporting outfall created for the purpose of regulating the sum of pollutant discharges via 001-009.	

Table 4-26. Summary of Permit Information for OCPSF Facilities Discharging Total Residual Chlorine

NPDES ID	Facility Name	Facility Location	SIC Code	Description	Outfall	Monthly Average TRC Limit	Daily Maximum TRC Limit	Outfall Waste-streams	Notes
TX0077577	Ineos Nitriles USA LLC. Green Lake Plant	Port Lavaca, TX	2869: Industrial Organic Chemicals; 2819: Industrial Inorganic Chemicals, NEC	Chemical plant manufacturing acrylonitrile, acetone cyanohydrin, acetonitrile, & catalyst.	001	1.0 mg/L (minimum limit after a detention time of at least 20 minutes)[i]		Demineralizer regenerant, boiler blowdown, cooling tower blowdown, RO reject, treated sanitary wastewater, supernatant from lime sludge pits.	No additional information on total residual chlorine discharges provided.

Source: (IA DNR, 2011, 2012a, 2012b, 2012c, 2013, 2014, 2016; NE DEQ, 2011, 2012, 2014, 2015; TCEQ, 2007, 2009, 2015, 2016a, 2016b; WV DEP, 2013a, 2013b, 2015a, 2015b)

TRC: total residual chlorine

[a] Formerly ADM Polymers.

[b] Formerly Amazing Energy LLC.

[c] No permit fact sheet available for this facility, limited background information provided in the facility permit.

[d] From the facility permit, Cargill Corn Milling is a large complex with multiple manufacturing facilities onsite. The complex has a privately owned wastewater treatment plant which treats process and non-process wastewater from the whole complex.

[e] The facility changed ownership in May 2016, it is now owned by Chief Ethanol Fuels, Inc.

[f] Seasonal TRC limits are included in the permit to ensure the effluent discharge does not exceed the acute and chronic instream water quality criteria.

[g] Facility has interim permit limits due to construction activities on site.

[h] Facility has monitoring only requirements until November 2017, then the permit limits become 0.08 mg/L (monthly average) & 0.16 mg/L (daily maximum).

[i] Facility has minimum total residual chlorine limit.

4.2.5 OCPSF Category Review of Nitrate Discharges

As described in Section 4.2.2, from the 2015 Annual Review, EPA identified 121 facilities with nitrate releases in the TRI data and concluded that further investigation of nitrate is appropriate to evaluate whether discharges are industry-wide and present at a level substantial enough for further treatment. Nitrate does not have limitations under the OCPSF ELGs and was not identified as a pollutant of concern during the development of the ELGs. Additionally, EPA has not conducted a detailed review of nitrate discharges as part of recent annual reviews or studies of the industry, outside of the preliminary review conducted as part of the 2015 Annual Review.

In the absence of a comparison point directly relevant to the OCPSF category, EPA compared the effluent nitrate concentration data to a baseline value for nitrate from the *Development Document for the Effluent Limitations Guidelines and Standards for the Centralized Waste Treatment Industry – Final* (CWT Development Document) (U.S. EPA, 2000). In general, the baseline value is equal to the nominal quantitation limit identified for the method (in the case of nitrate, EPA Method 1620). EPA also compared the concentration data to ten times the baseline value for nitrate from the CWT Development Document. EPA performed these comparisons to provide a frame of reference for the magnitude of the nitrate discharges and to generally assess whether the concentrations are at a level substantial enough for further treatment (in this case, ten times the baseline value for nitrate identified in the CWT Development Document is considered substantial enough for treatment).

In addition, EPA compared the concentration data for direct dischargers to the national primary drinking water regulation for nitrate. The national primary drinking water regulations apply to public water systems and protect drinking water quality by limiting the levels of contaminants that can adversely affect public health through setting maximum contaminant levels (MCLs). The drinking water regulations consider mixing zones and downstream mixing, while the DMR and TRI data result from facility effluent measurements, typically at the end of the discharge pipe. Therefore, this comparison merely provides a frame of reference for better understanding the magnitude of the nitrate discharges and their potential for posing a hazard. Table 4-27 presents the baseline comparison values and national primary drinking water regulation for nitrate.

Table 4-27. Baseline Values and Water Quality Criteria for Nitrate

Baseline Value for Nitrate (mg/L)[a]	10x Baseline Value for Nitrate (mg/L)	National Primary Drinking Water Regulation for Nitrate (mg/L)
0.05	0.5	10

Source: (U.S. EPA, 2000) (for the baseline values); (U.S. EPA, 2016e) (for the National Primary Drinking Water Regulations for nitrate).

Note: The baseline values and the National Primary Drinking Water Regulation for nitrate are reported as nitrate as nitrogen (NO_3-N).

[a] The baseline value is equal to the nominal quantitation limit identified for EPA Method 1620.

For the current review, EPA focused its evaluation on effluent concentrations of nitrate. As shown in Table 4-22, 120 facilities reported releases of nitrate to TRI in 2014 (includes both direct and indirect releases), while only 14 facilities reported nitrate discharges on 2014 DMRs.

Following the methodology outlined in Section 2.1.4, EPA obtained concentration data for 13 of the facilities reporting nitrate on DMRs in 2014.[25] Additionally, EPA identified and contacted eight facilities that reported direct and indirect releases of nitrate to TRI in 2014 to gather the underlying nitrate concentration data that formed the basis for the TRI-reported releases and identify sources of nitrate in wastewater. EPA compiled the DMR and TRI concentration data supporting this review (ERG, 2016). Table 4-28 presents the facilities EPA contacted along with information the facilities provided. All eight facilities listed in Table 4-28 provided underlying concentration data used to calculate nitrate releases reported to TRI. EPA presents its analysis of direct and indirect discharges of nitrate and comparison to baseline values and water quality criteria in Sections 4.2.5.1 and 4.2.5.2.

To further understand discharges and treatment of nitrate, EPA contacted select states that have a high proportion of OCPSF facilities with reported nitrate discharges. EPA also evaluated available treatment technology pollutant removal data. These analyses are presented in Sections 4.2.5.3 and 4.2.5.4, respectively.

[25] Only 13 OCPSF facilities have average nitrate concentration data out of a total of 14 OCPSF facilities with nitrate discharges greater than zero in the 2014 DMR data.

Table 4-28. Facilities Contacted to Obtain Underlying Concentration Data for Nitrate Releases Reported to TRI in 2014

Facility Name	Facility Location	Direct/Indirect Discharger	Facility Process & Treatment Technology Information	Concentration Data Provided[a]	Reference
DSM Chemicals	Augusta, GA	Direct	Facility produces caprolactam, a monomer used to make nylon 6 (for use in nylon fibers). Oxidation of organic raw materials during processing forms ammonia and nitrites. These compounds are then oxidized in the wastewater treatment plant to form nitrate.	Yes	(Connell, 2016)
Eastman Chemical Co. Tennessee	Kingsport, TN	Direct	No additional information provided.	Yes	(Smith, 2016)
Ascend Performance Materials Operations LLC – Decatur Plant	Decatur, AL	Direct	Nitrate discharges result from the facility's wastewater treatment plant.	Yes	(Burke, 2016)
BASF Corporation	Geismar, LA	Direct	Complex has many facilities on site, one of which manufactures dinitrotoluene (DNT). This process can lead to high levels of nitrate in process wastewater. BASF has incorporated anoxic zones in their treatment system to allow removal of nitrate and has seen removal rates of up to 99 percent in certain conditions.	Yes	(Hillman, 2016)
Invista Camden Plant	Lugoff, SC	Direct	Nitrate may be generated by the nitrification of organic nitrogen-containing compounds in the facility's aerobic biological wastewater treatment plant. The organic nitrogen-containing compounds result from wet scrubbers that capture vapor by-products from the production of nylon.	Yes	(Twait, 2016)
Honeywell International Inc. Hopewell Plant	Hopewell, VA	Both	No specific treatment for nitrate at the facility.	Yes	(Parker, 2016)
Eastman Chemical Resins Inc.	West Elizabeth, PA	Both	No additional information provided.	Yes	(Petrosky, 2016)
First Chemical Corp.	Pascagoula, MS	Indirect	No additional information provided.	Yes	(Field, 2016)

[a] EPA compiled the concentration data provided by the facilities into a spreadsheet to support the analyses discussed in this section (ERG, 2016).

4.2.5.1 Evaluation of Direct Discharge Nitrate Concentrations

EPA obtained and compared the 2014 nitrate concentration data for direct discharging OCPSF facilities to the baseline value, 10 times the baseline value, and the national primary drinking water regulation for nitrate, as identified in Table 4-27 (0.05 mg/L, 0.5 mg/L, and 10 mg/L, respectively). Table 4-29 presents a summary of the average OCPSF direct discharging facility nitrate DMR and TRI concentration data as well as these comparison values. As shown, the median concentrations for the TRI data and the DMR data fall an order of magnitude above 10 times the baseline value (0.5 mg/L). Both TRI and DMR median concentrations fall below the national primary drinking water regulation (10 mg/L). Approximately one third of the nitrate concentrations in both DMR and TRI data fall above the national primary drinking water regulation. These data suggest that nitrate may be present at a level significant enough for further treatment, but generally below concentrations deemed unacceptable for drinking water.

Table 4-29. Comparison of OCPSF Facility 2014 Average Direct Discharge Nitrate Concentration Data to Baseline Values and Drinking Water Standards

Data Type	Number of Data Points [a]	Average Nitrate Concentrations (mg/L)		
		Minimum	Median	Maximum
2014 OCPSF Facility TRI Data	12	0.01	2.41	141[b]
2014 OCPSF Facility DMR Data	14	0.09	2.90	68
Baseline Value	**0.05 mg/L**			
10x Baseline Value	**0.5 mg/L**			
National Primary Drinking Water Regulations for Nitrate (MCL)	**10 mg/L**			

Source: (ERG, 2016; U.S. EPA, 2000, 2016e).

[a] The number of data points represents the number of outfalls, not facilities. Some facilities have more than one outfall.

[b] The maximum concentration is likely an outlier. It is an order of magnitude, or more, higher than the nitrate concentrations reported by other direct discharging facilities.

4.2.5.2 Evaluation of Indirect Discharge Nitrate Concentrations

Only twelve OCPSF facilities (of the 120 that reported releases of nitrate to TRI in 2014) reported indirect releases of nitrate to TRI. EPA contacted three facilities and obtained the underlying concentration data that formed the basis for their reports of indirect nitrate releases to TRI. EPA compared these nitrate concentration data to the baseline value and10 times the baseline value for nitrate, shown in Table 4-27 (0.05 mg/L and 0.5 mg/L, respectively). Table 4-30 presents the average indirect discharging facility nitrate concentration for each of the three facilities. As shown, all three facilities' average nitrate concentrations are orders of magnitude higher than the baseline value and 10 times the baseline value. However, because of EPA's facility selection method, these data represent concentrations from facilities reporting the highest indirect releases of nitrate to TRI.

Table 4-30. Comparison of OCPSF Facility 2014 Average Indirect Discharge Nitrate Concentration Data to Baseline Values

Facility Name and Location	Average Nitrate Concentration
Honeywell International, Hopewell, VA	4.80 mg/L
Eastman Chemical, West Elizabeth, PA	199 mg/L
First Chemical Corp, Pascagoula, MS	77.7 mg/L
Baseline Value	**0.05 mg/L**
10x Baseline Value	**0.5 mg/L**

Source: (ERG, 2016; U.S. EPA, 2000)

4.2.5.3 Summary of Permit Reviews and Information Provided by States Regarding Discharges of Nitrate

As part of this review, EPA contacted WV DEP because West Virginia had the highest percentage of OCPSF facilities with nitrate discharges in DMR (five out of fourteen total). EPA's purpose was to collect additional information on the development of permit limits to further inform EPA's understanding of the nitrate discharges.

The WV DEP contact stated that if a facility reports nitrate discharges with their permit application, the state calculates the reasonable potential for discharge to violate water quality standards. The state uses the water quality standards along with facility-specific information to determine a permit limit. The state contact stated that nitrate limits are usually seen in permits from OCPSF facilities only if the facility manufactures organic chemicals containing nitrogen, as these facilities typically discharge nitrate at levels requiring further treatment (Lockhart, 2016). The state contact provided facility permits and fact sheets for the three OCPSF facilities with the largest nitrate discharges in the 2014 DMR data. Table 4-31 presents a summary of the permit information for these three OCPSF facilities, including nitrate permit limits or monitoring requirements. Only one of the facilities has permit limits for nitrate.

Table 4-31. Summary of Permit Information for Three West Virginia OCPSF Facilities

NPDES ID	Facility Name	Facility Location	SIC Code	Description	Outfall	Monthly Average Nitrate Limit	Daily Maximum Nitrate Limit	Outfall Waste Streams	Notes
WV0000787	Cytec Industries Inc.	Belmont, WV	2869: Industrial Organic Chemicals; 2899: Chemical Preparations	Organic Chemical Manufacturing.	001	11/1/15-10/31/17: Monitoring only	11/1/15-10/31/17: Monitoring only	Treated process wastewater, cooling water, treated ground water, and stormwater runoff.	Interim limits[a]
					001	11/1/17 – 6/30/19: Monitoring only	11/1/17 – 6/30/19: Monitoring only		Final limits
WV0000841	Sabic Innovative Plastics US LLC	Washington, WV	2822: Synthetic Rubber; 2821: Plastics Materials, Synthetic Resins	Manufacturing of ABS (acrylonitrile, butadiene, styrene) polymers.	001	93 mg/L	155 mg/L	Sanitary wastewater, stormwater runoff, process water, other.	None.
WV0116416	Kureha PGA, LLC	Belle, WV	Not provided.	Not provided.	001	Monitoring only	Monitoring only	Cooling water, stormwater runoff.	None.

Source: (WV DEP, 2013, 2015)
[a] Facility has interim permit limits due to construction activities on site.

4.2.5.4 Evaluation of Available Treatment Technology Performance Data for Nitrate

EPA reviewed recent literature compiled in the IWTT Database to identify emerging treatment technologies that are being evaluated and/or implemented within the OCPSF industry, or that are being evaluated and/or implemented in other industries, specifically for the removal of nitrate (for more information on the IWTT Database, see Section 6.2 of this report).

EPA queried the IWTT Database for treatment of OCPSF wastewater, which produced no articles with pollutant removal data. EPA then queried IWTT for performance data on the treatment of nitrate in general. Table 4-32 summarizes these systems and their treatment effectiveness. All but two are pilot scale. The systems described in Table 4-32 may not specifically target nitrate removal; however, they do remove high percentages of nitrate. The studies do not show consistent nitrate effluent concentrations, are mostly pilot scale, and are not specific to the OCPSF industry. In addition, the studies also evaluated process wastewater that likely was not commingled and potentially diluted by other non-process waste streams, as may be the case for the DMR nitrate data discussed above. Despite these caveats, the nitrate effluent concentrations are generally similar to or lower than the 2014 DMR OCPSF facility median nitrate concentrations discussed above.

Table 4-32. Summary of Wastewater Treatment Technologies for Nitrate

Parameter	Wastewater Treatment Technology (Order of Unit Processes)	Effluent Concentration (mg/L)	Percent Removal	Industry	Treatment Scale	Reference
Nitrate	Adsorptive Media	2	50.0%	Petroleum Refining	Full	(Hayes & Sherwood, 2012)
	Membrane Filtration, Ion Exchange, and Reverse Osmosis	2.8	88.8%		Pilot	(Ginzburg & Cansino, 2009)
	Aerobic Fixed Film Biological Treatment	NR	< 100%	Coal Mining	Full	(Reinsel, 2010)
	Flow Equalization, Membrane Filtration, and Reverse Osmosis	0.42	97.5%	Ferroalloy Manufacturing	Pilot	(Benito & Ruiz, 2002)
Nitrate (as N)	Anaerobic Fixed Film Biological Treatment and Membrane Filtration	0.01	99.9%	Coal Mining	Pilot	(Munirathinam, et al., 2011)
	Anaerobic Fixed Film Biological Treatment and Moving Bed Bioreactor	0.7	97.7%		Pilot	(Gay, et al., 2012)
	Ozonation	1.8	10.0%	Textile Mills	Pilot	(Somensi, et al., 2010)
	Granular-Media Filtration, Membrane Filtration, and Reverse Osmosis	0.73	51.3%	Electrical and Electronic Components	Pilot	(Huang, et al., 2011)

NR – Not Reported.

4.2.6 OCPSF Category NPRI Analysis

EPA evaluated the utility of using data from Canada's NPRI to identify potential additional pollutants that may be present in industrial wastewater discharges from facilities in the U.S., as indicated by their presence in industrial wastewater discharges from facilities in Canada. Section 2.2 of this report provides a general overview of the NPRI analysis and methodology. This section presents EPA's review of the NPRI data specific to the OCPSF Category.

4.2.6.1 NPRI Analysis Overview

EPA compared water release data in TRI to data reported in Canada's NPRI for the OCPSF Category to identify pollutants reported in NPRI, but not captured in the TRI. For those pollutants, EPA compared the reporting requirements between NPRI and TRI to understand the impact of any reporting differences (e.g., are the thresholds for reporting similar, do groups of reported chemicals include the same set of individual compounds, etc.) and further evaluated the potential for releases of these pollutants in the U.S.

For this analysis, EPA evaluated 2013 TRI and NPRI data, the most recent data available for both datasets at the time of review. EPA processed the data as described in Section 2.2 to obtain the relevant industry category, pollutant names, facility counts, and water releases for each of the datasets. For facilities associated with the OCPSF Category, EPA compared the list of pollutants with water releases reported to NPRI and TRI.

In 2013, 43 Canadian OCPSF facilities reported water release data for 42 pollutants to NPRI, while 644 U.S. OCPSF facilities reported water release data for 156 pollutants to TRI. As shown in Table 4-33, EPA identified nine pollutants reported to NPRI that were not reported to TRI by OCPSF facilities in 2013. Five of the nine pollutants are not included on the EPCRA Section 313 Chemical List for Reporting Year 2013 (2013 List of TRI Chemicals), therefore, facilities are not required to report releases of these pollutants (U.S. EPA, 2014b).

Table 4-33. Pollutants Reported by OCPSF Facilities to 2013 NPRI but not to 2013 TRI

Pollutant Name	On 2013 List of TRI Chemicals[a]	Number of NPRI OCPSF Facilities Reporting Pollutant Release to Water	Percentage of all NPRI OCPSF Facilities Reporting Water Release
2-Butoxyethanol	N	2	5%
Chlorine	Y[b]	1	2%
HCFC-123 and all isomers	Y	1	2%
HCFC-124 and all isomers	Y	1	2%
Isopropyl alcohol	Y	4	9%
Nonylphenol and its ethoxylates	N	2	5%
Octylphenol and its ethoxylates	N	2	5%
Phosphorus (total)	N[c]	10	23%
Sodium fluoride	N	1	2%

Source: *NPRICompare2013, TRILTOutput2013_v1*, (U.S. EPA, 2014b)
HCFC: Hydrochlorofluorocarbons
a Refers to pollutants included in the 2013 List of TRI Chemicals, regardless of whether water releases were reported for the pollutant.
b Chlorine is in gaseous form, and not expected to be released to water under typical conditions (U.S. EPA, 1998).
c The 2013 List of TRI Chemicals only includes Phosphorus (yellow or white). Yellow and white phosphorus, both allotropes of elemental phosphorus, are hazardous pollutants that spontaneously ignite in air. During the 2006 Annual Review, EPA identified that facilities were incorrectly reporting discharges of total phosphorus (i.e., the phosphorus portion of phosphorus-containing compounds) as phosphorus (yellow or white) (U.S. EPA, 2006). Therefore, EPA concluded that it was appropriate to exclude all phosphorus (yellow or white) discharges reported to TRI, and has made such adjustments to the data, beginning with the 2011 Annual Review (U.S. EPA, 2012). Total phosphorous (as reported in NPRI) is not included in the current List of TRI Chemicals (for reporting year 2015).

4.2.6.2 NPRI Pollutant Analysis

EPA identified nine pollutants reported to NPRI in 2013 that were not reported to TRI. All but phosphorus were reported to NPRI by less than 20 percent of reporting facilities. Because phosphorus was reported to NPRI by 23 percent of facilities, EPA performed a more in-depth analysis of this pollutant.

No OCPSF facilities reported total phosphorus releases to TRI in 2013 because total phosphorus is not a TRI-listed pollutant. However, TRI does include one form of phosphorous on the 2013 List of TRI Chemicals, known as yellow or white phosphorus (U.S. EPA, 2014b). Historically, as part of its annual review process EPA excludes yellow or white phosphorus reported to TRI from its analyses because this elemental form of phosphorus is insoluble in water and is not the same form of phosphorus commonly measured in wastewater (U.S. EPA, 2012). According to NPRI reporting guidance, total phosphorus does not include yellow or white phosphorus; NPRI includes yellow or white phosphorus as a separate pollutant (Environment Canada, 2015).

EPA compared the magnitude of the phosphorus releases reported in NPRI to available 2013 DMR data for phosphorus. The 2013 NPRI total phosphorus releases ranged from 2 pounds to 2,200 pounds, as shown in Table 4-34. The total phosphorus discharges reported by the top ten discharging OCPSF facilities in DMR range from 8,720 pounds to 190,000 pounds, as shown in Table 4-35. These top ten facilities account for approximately 90 percent of the total 2013 DMR total phosphorus discharges reported by OCPSF facilities. In general, total phosphorus releases reported by OCPSF facilities on DMRs in the U.S. are higher than total phosphorus releases reported in NPRI.

Though several facilities report total phosphorous discharges on DMRs, phosphorus does not have limitations under the OCPSF ELGs. In addition, EPA has not previously reviewed total phosphorous discharges for the OCPSF industry as part of recent annual reviews. Total phosphorous does not have an associated toxic weighting factor and subsequently does not appear in EPA's TRA. See Section 2 of EPA's 2015 Annual Review Report for more information on toxic weighting factors and EPA's TRA (U.S. EPA, 2016a).

Table 4-34. Top 2013 OCPSF Facilities Reporting Total Phosphorus Releases to NPRI

Facility Name	Facility Location	Direct Pounds of Pollutant Released	Indirect Pounds of Pollutant Released	Total Pounds of Pollutant Released
London	London, ON	0	2,200	2,200
Welland Plant	Niagara Falls, ON	2,000	0	2,000
Jungbunzlauer Canada Inc.	Port Colborne, ON	1,820	0	1,820
Same	Lachine, QC	0	441	441
Novozymes Canada	Ottawa, ON	0	313	313
Mississauga Plant	Mississauga, ON	0	284	284
Virox Oakville	Oakville, ON	0	185	185
Burlington	Burlington, ON	0	165	165
Longford Mills Plant	Longford Mills, ON	7.50	0	7.50
Winnipeg (Ms54)	Winnipeg, MB	0	2	2
Total		**3,830**	**3,600**	**7,430**

Source: (Environment Canada, 2014).
Note: Facilities report pounds of pollutant released directly to surface waters or indirectly to POTWs.

Table 4-35. Top 2013 OCPSF Facilities Reporting Total Phosphorus Discharges on DMRs

Facility Name	Facility Location	Pounds of Pollutant Discharged
ICL-LP America, Inc.	Gallipolis Ferry, WV	190,000
Cytec Industries, Inc.	Willow Island, WV	54,700
Dupont Fayetteville Plant	Fayetteville, NC	48,700
Honeywell International, Inc. Hopewell Plant	Hopewell, VA	36,900
Dak Americas LLC Cape Fear Site	Leland, NC	17,600
MPM Silicones LLC	Friendly, WV	16,000
Eastman Chemical Co. South Carolina Operations	West Columbia, SC	13,700
Dupont Spruance Plant	Richmond, VA	12,900

Table 4-35. Top 2013 OCPSF Facilities Reporting Total Phosphorus Discharges on DMRs

Facility Name	Facility Location	Pounds of Pollutant Discharged
Sabic Innovative Plastics U.S. LLC	Washington, WV	10,600
Geo Specialty Chemicals Trimet Products Group	Allentown, PA	8,720
All other OCPSF dischargers of total phosphorus (44 additional facilities)		43,900
Total		**454,000**

Source: *DMRLTOutput2013_v1*.

4.2.7 Summary of the OCPSF Category Review

From its evaluation of total residual chlorine and nitrate discharges, EPA learned:

- *Total residual chlorine.* Total residual chlorine does not have limitations under the OCPSF ELGs; however, EPA identified 102 facilities with reported discharges on 2014 DMRs. The review of DMR average concentration data demonstrated that the median total residual chlorine concentration for OCPSF facilities falls just below the maximum (acute) concentration aquatic life water quality criterion (0.019 mg/L), but above the continuous (chronic) concentration aquatic life water quality criterion (0.011 mg/L) for total residual chlorine. This comparison provides an indication that the magnitude of any hazard associated with total residual chlorine discharges is relatively small.

  The review of facility permit limits and discussion with state permitting authorities demonstrated that total residual chlorine is often added to cooling tower blowdown and other non-process wastewater to inhibit biological growth. Discussions with the IA DNR and NE DEQ suggest that (at least in these states), the permitted waste stream is subsequently dechlorinated using sodium bisulfate/bisulfite. Additionally, some facilities, specifically in Texas and West Virginia, combine sanitary wastewater with non-process or process wastewater. In Texas, state code establishes requirements for disinfection of facility effluent, and in these instances, facility permits establish a minimum total residual chlorine limit of 1.0 mg/L, often without establishing daily maximum and monthly average permit limits for total residual chlorine. Iowa, Nebraska, and West Virginia indicated that total residual chlorine limits are based on state water quality criteria, that consider mixing zones and other factors applied when deriving water quality-based permit limits.

  Collectively, the data suggest that OCPSF facilities may be adding chlorine to disinfect cooling tower water or other non-process wastewater, or to disinfect commingled sanitary wastewater. In states other than Texas, facilities have daily maximum or monthly average total residual chlorine permit limits based on water quality criteria designed to protect the receiving water body.

- *Nitrate.* Nitrate does not have limitations under the OCPSF ELGs; however, EPA identified 120 facilities with reported releases to TRI in 2014. The review of available facility nitrate concentration data in DMR and data provided by facilities reporting to

TRI demonstrated that the majority of nitrate concentrations are likely present at levels that could be reduced by further treatment based on a comparison to the baseline value and the national primary drinking water regulation for nitrate. The review of available treatment technology information in IWTT for industries other than OCPSF demonstrated that the effluent concentrations associated with these treatment technologies are generally lower than the 2014 DMR OCPSF facility median nitrate concentrations; however, the technologies reviewed did not specifically target nitrate removals and were not specifically applied to OCPSF wastewater.

- EPA's review of NPRI identified nine pollutants that were reported to NPRI in 2013, but not to TRI. EPA focused its review on total phosphorus, as it was the only pollutant reported by more than 20 percent of the OCPSF facilities to the 2013 NPRI. TRI does not require facilities to report discharges of total phosphorus, therefore, EPA compared the magnitude of the 2013 NPRI discharges to total phosphorus discharges reported in 2013 DMR data. In general, total phosphorus releases reported by OCPSF facilities on DMRs in the U.S. are higher than total phosphorus releases reported in NPRI.

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4.3 Pulp, Paper, and Paperboard (40 CFR Part 430)

As part of the 2015 Annual Review, EPA initiated a preliminary category review of the Pulp, Paper, and Paperboard (Pulp and Paper) Category because it ranked high, in terms of toxic-weighted pound equivalents (TWPE), in the final 2015 toxicity rankings analysis (TRA) (U.S. EPA, 2016a). EPA previously reviewed discharges from this category as part of the Preliminary and Final Effluent Guidelines Program Plans in 2004 – 2013 (U.S. EPA, 2004, 2006b, 2007, 2008, 2009b, 2011, 2012, 2014a, 2014b). During its 2006 Effluent Guidelines Program Plan development, EPA also conducted a detailed study of this category (U.S. EPA, 2006a).

From its 2015 TRA and preliminary category reviews, EPA decided that the Pulp and Paper Category warrants further review, specifically related to the discharges of lead and lead compounds (lead), mercury and mercury compounds (mercury), manganese and manganese compounds (manganese), and hydrogen sulfide (U.S. EPA, 2016b). The Pulp and Paper Category effluent limitations guidelines and standards (ELGs) do not regulate any of these pollutants. As part of this review, EPA further evaluated the discharges of these pollutants to:

- Understand the process operations at pulp and paper mills that generate the pollutants and how the mills are currently managing their wastewater.
- Understand how permitting authorities currently regulate discharges of the pollutants.
- Decide if the concentrations of lead, mercury, or manganese in effluent discharges are present at levels that could be reduced by further treatment.
- Review more recent data, specifically for hydrogen sulfide, to identify any changes in releases reported since the 2015 Annual Review.
- Identify advances in industrial wastewater treatment technology performance for reducing discharges of the pollutants.
- Identify additional pollutants potentially present in mill industrial wastewater discharges in the U.S., not currently captured in discharge monitoring report (DMR) data or Toxics Release Inventory (TRI) data.

Section 4.3.1 provides a background of the Pulp and Paper Category (40 CFR Part 430), and Section 4.3.2 provides a summary of the results of the previous ELG planning review related to the Pulp and Paper Category. Sections 4.3.3 through 4.3.6 present EPA's current review approach and evaluation of the Pulp and Paper Category, including results from EPA's continued review of the top pollutants in the category, evaluation of available treatment technology performance, and the results of the additional pollutant analysis. Section 4.3.7 summarizes EPA's current review of the Pulp and Paper Category.

4.3.1 Pulp and Paper Category Background

The Pulp and Paper Category includes mills that manufacture pulp from wood and other fibers, produce paper and paperboard from pulp, or convert paper and paperboard into products such as boxes, bags, and envelopes (U.S. EPA, 2009a). Pulp and paper mills vary in size, age, location, raw materials used, products manufactured, production processes, and effluent treatment systems. The following subsections present an overview of the Pulp and Paper Category ELGs and their applicability.

4.3.1.1 Pulp and Paper ELGs

EPA promulgated initial ELGs for the Pulp and Paper Category (40 CFR Part 430) in 1974 and 1977, amended the regulations in 1982 and 1986, and promulgated a major amendment covering toxic pollutants in certain subcategories in 1998. The 1998 "Cluster Rule" also promulgated toxic air emission standards (national emission standards for hazardous air pollutants (NESHAPs)) for the industry under the Clean Air Act. The ELGs regulate discharges from 12 subcategories, shown in Table 4-36. For a more detailed history of the existing regulation, see EPA's 2006 detailed study report for the pulp and paper industry (U.S. EPA, 2006a).

Table 4-36. Pulp and Paper ELGs Subcategories

Subpart	Subcategory
A	Dissolving Kraft
B	Bleached Papergrade Kraft and Soda
C	Unbleached Kraft
D	Dissolving Sulfite
E	Papergrade Sulfite
F	Semi-Chemical
G	Mechanical Pulp
H	Non-Wood Chemical Pulp
I	Secondary Fiber Deink
J	Secondary Fiber Non-Deink
K	Fine and Lightweight Papers from Purchased Pulp
L	Tissue, Filter, Non-Woven, and Paperboard from Purchased Pulp

Source: 40 CFR Part 430

4.3.1.2 Pulp and Paper Category Applicability

The Pulp and Paper regulation applies to any pulp, paper, or paperboard mill that discharges or may discharge process wastewater pollutants to the waters of the United States, or that introduces or may introduce process wastewater pollutants into a publicly owned treatment works (POTWs). For the purpose of its annual reviews, EPA considers the following 25 North American Industry Classification System (NAICS) codes and eight Standard Industrial Classification (SIC) codes to be part of the Pulp and Paper Category, as identified from the NAICS-Point Source Category (NAICS-PSC) and SIC-PSC crosswalks developed for the 304m Annual Review (U.S. EPA, 2009b). The 25 NAICS codes are:

- NAICS 321113: Sawmills
- NAICS 322110: Pulp Mills
- NAICS 322121: Paper (except Newsprint) Mills
- NAICS 322122: Newsprint Mills

- NAICS 322130: Paperboard Mills
- NAICS 322211: Corrugated and Solid Fiber Box Manufacturing
- NAICS 322212: Folding Paperboard Box Manufacturing
- NAICS 322214: Fiber Can, Tube, Drum, and Similar Products Manufacturing
- NAICS 322215: Nonfolding Sanitary Food Container Manufacturing
- NAICS 322221: Coated and Laminated Packaging Paper Manufacturing
- NAICS 322222: Coated and Laminated Paper Manufacturing
- NAICS 322224: Uncoated Paper and Multiwall Bag Manufacturing
- NAICS 322231: Die-Cut Paper and Paperboard Office Supplies Manufacturing
- NAICS 322291: Sanitary Paper Product Manufacturing
- NAICS 322299: All Other Converted Paper Product Manufacturing
- NAICS 322211: Corrugated and Solid Fiber Box Manufacturing
- NAICS 322212: Folding Paperboard Box Manufacturing;
- NAICS 322214: Fiber Can, Tube, Drum, and Similar Products Manufacturing
- NAICS 322215: Nonfolding Sanitary Food Container Manufacturing
- NAICS 322221: Coated and Laminated Packaging Paper Manufacturing
- NAICS 322222: Coated and Laminated Paper Manufacturing
- NAICS 322224: Uncoated Paper and Multiwall Bag Manufacturing
- NAICS 322231: Die-Cut Paper and Paperboard Office Supplies Manufacturing
- NAICS 322299: All Other Converted Paper Product Manufacturing
- NAICS 326112: Plastics Packaging Film and Sheet (including Laminated) Manufacturing

The eight SIC codes are:

- SIC 2653: Corrugated and Solid Fiber Boxes
- SIC 2655: Fiber Cans, Tubes, Drums, and Similar Products
- SIC 2656: Sanitary Food Containers, Except Folding
- SIC 2657: Folding Paperboard Boxes, Including Sanitary
- SIC 2671: Packaging Paper and Plastics Film, Coated and Laminated
- SIC 2672: Coated and Laminated Paper, Not Elsewhere Classified
- SIC 2674: Uncoated Paper and Multiwall Bags
- SIC 2679: Converted Paper and Paperboard Products, Not Elsewhere Classified

In 1980, EPA estimated that the Pulp and Paper ELGs applied to approximately 706 mills. Approximately 378 mills discharged directly to surface waters, 248 mills discharged indirectly to POTWs, and 12 mills had both direct and indirect discharges. Additionally, 54 mills recycled their wastewater (no discharge). EPA did not categorize the remaining 14 mills due to insufficient data (U.S. EPA, 1980).

EPA identified 233 pulp and paper mills reporting water releases to TRI in 2014, with 158 mills reporting direct releases to surface waters, 67 mills reporting indirect releases to POTWs, and eight mills reporting both direct and indirect releases (*TRILTOutput2014_v1*). EPA identified 154 pulp and paper mills that submitted 2014 DMR data to the Integrated Compliance Information System for the National Pollutant Discharge Elimination System (ICIS-NPDES) (*DMRLTOutput2014_v1*). While these numbers appear to show a decline in the number of pulp and paper mills discharging since the 1980s, due to the limitations of the DMR and TRI datasets, EPA does not have an exact count of how many mills currently are subject to the Pulp and Paper ELGs. See Section 2.1 for a discussion on the limitations of DMR and TRI data.

4.3.2 Summary of the Results of the 2015 Annual Review for the Pulp & Paper Category

During the 2015 Annual Review, EPA identified TRI releases of lead, mercury, manganese, and hydrogen sulfide for further review. The paragraphs below summarize the results of EPA's previous review regarding these four pollutants (U.S. EPA, 2016b).

- *Lead and mercury.* In 2013, 172 mills reported lead releases and 84 mills reported mercury releases, out of a total of 226 mills reporting water releases to TRI. The Pulp and Paper ELGs do not regulate either of these pollutants. EPA concluded that further investigation of these pollutants is appropriate to evaluate if concentrations are present in mill effluent at a level that may warrant further treatment.
- *Manganese.* In 2013, 112 mills reported releases of manganese out of a total of 226 mills reporting water releases to TRI. Further, it has been nearly 10 years since EPA conducted the Pulp and Paper detailed study in which it evaluated and compared manganese concentrations to treatable levels. For these reasons, EPA concluded that further investigation of manganese is appropriate to evaluate whether concentrations are present in mill effluent at levels that warrant further treatment.
- *Hydrogen sulfide.* Hydrogen sulfide was added as a TRI reporting requirement in 2012. In 2013, 98 mills reported hydrogen sulfide releases to TRI; seven mills accounted for 80 percent of the hydrogen sulfide releases, with the top mill accounting for 27 percent of the releases. The top mill confirmed their 2013 TRI hydrogen sulfide release data but stated that wastewater treatment system improvements had led to decreased hydrogen sulfide discharges in 2014. EPA contacted industry trade associations and learned that pulp and paper mills may use total sulfide, rather than dissolved sulfide concentrations, to calculate their hydrogen sulfide releases. Industry trade associations suggest that this may result in overestimates. One trade association has developed a new sampling system that may enable improved measurement of dissolved sulfides, and thus mitigate the overestimates of hydrogen sulfide releases in TRI. Due to the number of mills with hydrogen sulfide releases in TRI, lack of historical release data (releases have only been reported to TRI since 2012), and possible overestimation of hydrogen sulfide releases in TRI due to the current measurement convention, EPA concluded that it is appropriate to continue to monitor releases of hydrogen sulfide to evaluate whether they potentially represent a category-wide issue.

4.3.3 Introduction to EPA's Current Evaluation of Specific Pollutants in the Pulp & Paper Category

For the current review, EPA evaluated the discharges of lead, mercury, manganese, and hydrogen sulfide to satisfy the objectives outlined above in Section 4.3. The Pulp and Paper ELGs do not regulate any of these pollutants. Specifically, EPA:

- Evaluated available 2014 DMR and TRI data[26] for the four pollutants, including concentration data reported on DMRs.
- Contacted several pulp and paper mills through two pulp and paper trade associations, the American Forest and Paper Association (AF&PA) and the National Council for Air and Stream Improvement (NCASI),[27] reporting releases of lead, mercury, manganese and hydrogen sulfide to TRI to gather information on process operations contributing to those releases, wastewater treatment technologies, and discharged concentrations.
- Reviewed the results and compared current discharge concentrations to relevant data collected during the 2006 pulp and paper detailed study.
- Researched the performance of available treatment technologies in the Industrial Wastewater Treatment Technology (IWTT) Database for the pollutants.
- Contacted state permitting authorities to further understand the development of pollutant permit limits and current processes for managing wastewater containing these pollutants.
- Reviewed available data in Canada's National Pollutant Release Inventory (NPRI) to identify additional pollutants that may be present in pulp and paper mill wastewater discharges that are not reported in the U.S. under the TRI or DMR programs.

Table 4-37 compares the 2013 and 2014 TRI TWPE and the number of mills reporting releases of the four pollutants. Section 4.3.4 presents EPA's analyses and results related to lead, mercury, and manganese. Section 4.3.5 presents EPA's analyses and results related to hydrogen sulfide. Section 4.3.6 presents EPA's analysis of the NPRI data.

[26] EPA evaluated 2014 data because it represented the most current and complete DMR and TRI dataset available at the start of this review. Note that EPA evaluated 2013 DMR and TRI data in support of the 2015 Annual Review.

[27] AF&PA is the national trade association of the forest, pulp, paper, paperboard, and wood products industry. NCASI is a nonprofit research institute funded by the North American forest products industry, including pulp and paper mills.

Table 4-37. 2013 and 2014 TRI TWPE and Number of Pulp and Paper Mills Discharging Lead, Mercury, Manganese, and Hydrogen Sulfide

Pollutant	2013 TRI Data		2014 TRI Data	
	Number of Mills [a]	TWPE	Number of Mills [a]	TWPE
Lead	172	47,700	175	49,100
Mercury	84	46,500	86	43,700
Manganese	112	318,000	110	455,000[b]
Hydrogen Sulfide	98	1,190,000	95	1,230,000
Total for All Pollutants Reported	**226**	**1,820,000[c]**	**233**	**3,000,000[d]**

Sources: *TRILTOutput2014_v1*; *TRILTOutput2013_v1*.
Note: Sums of individual values may not equal the total presented due to rounding.
[a] Number of pulp and paper mills with TWPE greater than zero.
[b] The increase in the TRI manganese TWPE from 2013 to 2014 can be attributed to increases in reported manganese releases from the top mills.
[c] Total includes corrected data as identified during the 2015 Annual Review (U.S. EPA, 2016a).
[d] EPA did not complete a comprehensive quality review of the remainder of the 2014 TRI data; therefore, this total may include outliers. See Section 2.1 for more information.

4.3.4 Pulp and Paper Category Review of Lead, Mercury, and Manganese Discharges

During the 2006 detailed study, EPA identified metals as the second largest contributor (after dioxin) to the total toxic discharges (based on TWPE) for the Pulp and Paper Category. For this reason, EPA analyzed metals discharges, including discharges of lead, mercury, and manganese, from pulp and paper mills. As part of the study, EPA collected information about the concentrations of metals in pulp and paper mill discharges from NPDES Permit Renewal Application (Form 2C) data.[28] EPA compared the Form 2C concentrations to analytical method minimum levels (MLs),[29] shown in Table 4-38, calculated from the method detection limits (MDLs) listed in Method 200.7.[30] The comparison shows that lead and mercury were discharged at concentrations below their respective MLs, whereas manganese discharges were well above the ML. After further review of manganese discharges, EPA concluded that manganese concentrations are frequently higher in mill intake than in mill effluent, and that the expense of treatment technologies targeting manganese make such technologies infeasible. Therefore, pollution control strategies for manganese, such as minimizing spent pulping liquor losses, may

[28] When mills file applications for new or revised NPDES permits, they must complete a Form 2C, which requires analyses of certain pollutants. Effluent data requirements vary depending on the types of pollutants the permitting authority expects to be present in a mill's wastewater. As part of the 2006 Detailed Study, EPA obtained copies of Form 2Cs from 28 direct discharging mills, all in the eastern United States (U.S. EPA, 2006a).

[29] MLs represent the smallest quantity of a metal that can be reliably measured by the analytical method (U.S. EPA, 2006a).

[30] EPA calculated the MLs by multiplying the MDL by 3.18 and rounding to the nearest 2,5, or $10x10^n$ (where n is an integer). See Method 200.7, Revision 5: Trace Elements in Water, Solids, and Biosolids by Inductively Coupled Plasma-Atomic Emission Spectrometry.

be the best strategy for reducing manganese discharges from pulp and paper mills[31] (U.S. EPA, 2006a).

Table 4-38. Method ML and Form 2C Effluent Lead, Mercury, and Manganese Concentrations (µg/L)

Pollutant	Method ML (µg/L)[a]	Form 2C Effluent Median Concentration (µg/L)
Lead	20	16.8
Mercury	0.2	0.1
Manganese	2	556

Source: (U.S. EPA, 2006a).
[a] Mercury method 245.1; Lead and manganese method 200.7.

For the current review, EPA obtained 2014 mill direct and indirect discharge concentrations of lead, mercury, and manganese from pulp and paper mills following the methodology outlined in Section 2.1.4. Specifically, EPA compiled average concentration data for lead, mercury, and manganese reported on DMRs. Additionally, EPA identified and contacted 15 mills (through AF&PA and NCASI, pulp and paper trade associations) to understand reported releases to TRI and gather underlying lead, mercury, and manganese concentration data that formed the basis for the TRI-reported direct and indirect releases of lead, mercury, and manganese (compiled in (ERG, 2016) and summarized below). Table 4-39 presents the mills EPA contacted along with information the mills provided regarding sources of metals in the wastewater. None of the mills have treatment technologies installed specifically targeting the removal of lead, mercury, or manganese. All mills listed in Table 4-39 provided underlying concentration data used to calculate lead, mercury, and manganese releases that they reported to TRI except Verso Paper in Bucksport, ME; this mill closed in 2015 (Schwartz & Wiegand, 2016).

EPA compared the DMR and TRI-based concentration data to information collected during the 2006 detailed study to provide a frame of reference for the magnitude of the discharges and to evaluate if concentrations have changed over the last 10 years. EPA also reviewed recent literature compiled in the IWTT Database to identify emerging treatment technologies that are being evaluated and/or implemented within the pulp and paper industry, or that are being evaluated and/or implemented in other industries, specifically for the removal of lead, mercury, or manganese (for more information on the IWTT Database, see Section 6.2 of this report). EPA presents its analysis of the concentration data and available treatment technology performance data for lead, mercury, and manganese in Sections 4.3.4.1 through 4.3.4.3, respectively.

From EPA's discussions with AF&PA and NCASI, the trade associations also provided general information on the sources of lead, mercury, and manganese in pulp and paper mill wastewater discharges. The trade associations stated that trace amounts of these metals may be present in treated pulp mill wastewaters due to their presence in certain solid or liquid fuels or

[31] Additional pollution control strategies for manganese include dry disposal of green liquor dregs and lime mud, dry removal of soil (dirt) from logs prior to debarking and chipping, conversion from alum precipitation water treatment to reverse osmosis treatment, and minimizing paper machine losses (U.S. EPA, 2006a).

bark used in manufacturing operations. The metal compounds in fuels or bark may enter the wastewater treatment system after combustion if the mill uses wet air pollution control or has wet ash-handling operations. Other potential sources include metals found in process additives such as sulfuric acid, sodium hydroxide, or clay fillers used in papermaking. The mills do not add lead, mercury, or manganese during the manufacturing process (Schwartz & Wiegand, 2016).

To further understand the discharges and treatment of lead, mercury, and manganese, EPA contacted select states that have a high proportion of pulp and paper mills with lead, mercury, and manganese discharges, presented in Section 4.3.4.4.

Table 4-39. Mills Contacted to Obtain Underlying Concentration Data for Pollutant Releases Reported to TRI in 2014

Mill Name	Mill Location	Direct/Indirect Discharger	Source of Metals in Wastewater	Pollutants for which the Mill Provided Concentration Data[a]	Mill Subcategory[b]
Appvion, Inc.	Roaring Spring, PA	Direct	No additional information provided.	Lead, Mercury, Manganese	B
Brunswick Cellulose LLC	Brunswick, GA	Direct	The mill performed a mercury minimization plan in 2006 and identified that sulfuric acid, hydrogen peroxide, and caustic soda represented greater than 99.6 percent of the total mercury brought into the mill in process chemicals. Consequently, the mill has requested low-level mercury reports from suppliers and only buys from suppliers that demonstrate mercury concentrations in their chemicals are less than 25 percent of the industry average.	Lead, Mercury, Manganese	B
Domtar Ashdown Mill	Ashdown, AR	Direct	No additional information provided.	Lead, Mercury, Manganese	B
Georgia-Pacific Crossett	Crossett, AR	Direct	A large source of mercury and manganese at the mill is due to the mercury content in the surface water that the mill utilizes for process water. The mill has a mercury minimization plan and works with the City of Crossett to decrease mercury levels. Lead discharges likely result from source wood.	Lead, Mercury, Manganese	B
Georgia-Pacific Monticello LLC	Monticello, MS	Direct	No additional information provided.	Lead, Mercury, Manganese	C
International Paper	Prattville, AL	Direct	No additional information provided.	Lead, Manganese	C
International Paper	Valliant, OK	Direct	No additional information provided.	Lead, Manganese	C
International Paper Georgetown Mill	Georgetown, SC	Direct	No additional information provided.	Lead, Mercury, Manganese	B
International Paper Texarkana Mill	Queen City, TX	Direct	No additional information provided.	Lead, Mercury, Manganese	Not provided

Table 4-39. Mills Contacted to Obtain Underlying Concentration Data for Pollutant Releases Reported to TRI in 2014

Mill Name	Mill Location	Direct/Indirect Discharger	Source of Metals in Wastewater	Pollutants for which the Mill Provided Concentration Data[a]	Mill Subcategory[b]
PH Glatfelter Co. Chillicothe Mill	Chillicothe, OH	Direct	Lead and manganese discharges result from source wood; mercury discharges result from coal-fired boilers.	Lead, Mercury, Manganese	B
SD Warren Co.	Skowhegan, ME	Direct	Mercury discharges result from use of sulfuric acid as a process chemical. The mill now requires the supplier to submit an analysis of mercury content on a routine basis.	Lead, Mercury, Manganese	B
Verso Paper Bucksport Mill	Bucksport, ME	Direct	Mill closed in 2015, no information received.		
Blandin Paper Co.	Grand Rapids, MN	Indirect	No additional information provided.	Lead, Mercury	G
Graphic Packaging International, Inc.	Macon, GA	Indirect	No additional information provided.	Lead, Mercury, Manganese	C
Luke Paper Co.	Luke, MD	Indirect	The mill identified that the source of lead discharges is lead projectiles used in the lime kiln to break up chunks of lime.	Lead, Mercury	B

Sources: (Schwartz & Wiegand, 2016).

[a] EPA compiled the concentration data provided by the mills into a spreadsheet to support the analyses discussed in this section (ERG, 2016).

[b] The mills provided the applicable subcategory. Subcategories include: Subcategory B: Bleached Papergrade Kraft and Soda; Subcategory C: Unbleached Kraft Subcategory; Subcategory G: Mechanical Pulp.

4.3.4.1 Evaluation of Lead Discharge Concentration

For this analysis, EPA compiled lead concentration data for a total of 21 pulp and paper mills; seven mills reported data on 2014 DMRs, 11 mills reported direct releases to TRI, and three mills reported indirect releases to TRI in 2014. Per the methodology outlined in Section 2.1.4, EPA calculated yearly average concentrations from these mills to use in subsequent analyses (ERG, 2016). EPA compared current discharge concentrations to relevant data collected during the 2006 study as well as available treatment technology performance data in IWTT.

Evaluation of Direct Discharge Lead Concentrations

EPA compared the 2014 lead concentration data for direct discharging pulp and paper mills to the Form 2C median concentration identified during the 2006 study and the Method 200.7 ML for lead.

Table 4-40 summarizes the 2014 direct discharge lead concentration data, including the minimum, median, and maximum concentrations, and number of data points for the DMR and TRI data. As shown, the median concentrations for both the DMR and TRI data are an order of magnitude below the 2006 Form 2C median concentration and Method 200.7 ML. The data suggest that lead discharges from direct discharging mills are below treatable levels, consistent with information from the 2006 detailed study.

Table 4-40. Comparison of Pulp and Paper Mill 2014 Average Direct Discharge Lead Concentration Data to 2006 Form 2C Data and the Method ML

Data Type	Number of Data Points[a]	Average Lead Concentrations (µg/L)		
		Minimum	Median	Maximum
2014 Pulp and Paper Mill DMR Data	7	0.00497	2.08	5
2014 Pulp and Paper Mill TRI Data	11	Non-detect	1	250[b]
2006 Form 2C Median Concentration for Lead	**16.8 µg/L**			
Method 200.7 ML for Lead	**20 µg/L**			

Sources: (ERG, 2016; U.S. EPA, 2006a).

a The number of data points represents the number of outfalls, not mills. Some mills have more than one outfall.

b The maximum concentration data point is an outlier. According to Georgia-Pacific Crossett in Crossett, AR, lead was non-detect; however, in accordance with TRI guidance, the mill based its annual loads reported to TRI on a release concentration of 0.25 mg/L (250 µg/L), which they took to represent half the detection limit (Schwartz & Wiegand, 2016). EPA notes that the detection limit the mill uses in its analysis and reporting to TRI is also higher than the Method 200.7 ML for lead.

Evaluation of Indirect Discharge Lead Concentrations

The majority of pulp and paper mills are direct dischargers; therefore, the dataset is limited for indirect discharging mills. To evaluate indirect discharges of lead, EPA compared current lead concentrations in effluent from three mills to the Method 200.7 ML concentration for lead. The three average concentrations shown in Table 4-41 all fall below the Method 200.7 ML. Consistent with the data for direct discharges, these data suggest that indirect lead discharges are below treatable levels.

Table 4-41. Comparison of Pulp and Paper Mill 2014 Average Indirect Discharge Lead Concentration Data to the Method ML

Mill Name and Location	Average Lead Concentration
Luke Paper Co., Luke, MD	5 µg/L
Blandin Paper, Co., Grand Rapids, MN	11.2 µg/L
Graphic Packaging International Inc., Macon, GA	16 µg/L
Method 200.7 ML for Lead	**20 µg/L**

Source: (ERG, 2016; U.S. EPA, 2006a).

Treatment of Lead in Pulp and Paper Wastewater

EPA queried the IWTT Database for performance data on the treatment of lead, not specifically limiting its search to pulp and paper mills. Table 4-42 summarizes the identified treatment systems and their effectiveness. EPA did not identify any studies specifically citing lead removal in the pulp and paper industry. However, other industries, such as metal finishing and ore mining and dressing, remove metals using membrane bioreactors, membrane filtration, and adsorptive media. Three of the four studies with lead removal data show lead effluent concentrations ranging from <1 to 4 µg/L and removal efficiencies ranging from 76.7 to 96.7 percent. These concentrations are similar to the 2014 median lead concentrations identified during this review and are well below the Method 200.7 ML for lead (20 µg/L). Therefore, the studies do not demonstrate the availability of technologies that can reduce lead concentrations to below levels currently measured in pulp and paper mill discharges.

Table 4-42. Summary of Wastewater Treatment Technology Data for Lead in IWTT

Wastewater Treatment Technology (Order of Unit Processes)	Effluent Lead Concentration (µg/L)[a]	Percent Removal	Industry	Treatment Scale	Reference
Membrane Bioreactor	1	76.7%	Metal finishing	Pilot	(Buckles, et al., 2003)
Bag and Cartridge Filtration, Oil/Water Separation, Flow Equalization, and Membrane Filtration	4	95.0%		Pilot	(Pugh, et al., 2014)
Membrane Bioreactor and Aeration	52.8	96.7%	Ore mining and dressing	Pilot	(Progress, et al., 2012)
Mechanical Pre-Treatment, Flow Equalization, Oil/Water Separation, Membrane Bioreactor, and Adsorptive Media	< 1	> 76.7%	Transportation equipment cleaning	Full	(Buckles, et al., 2007)

NR – Not Reported

[a] Studies reported effluent concentration data in mg/L. EPA converted the data to µg/L to facilitate comparison with mill effluent lead concentrations.

4.3.4.2 Evaluation of Mercury Discharge Concentrations

EPA compiled mercury concentration data for 26 pulp and paper mills; 14 from data reported on 2014 DMRs, nine from mills reporting direct releases to TRI, and three from mills reporting indirect releases to TRI in 2014. Per the methodology outlined in Section 2.1.4, EPA calculated the yearly average concentrations from these mills to use in subsequent analyses (ERG, 2016). EPA compared current discharge concentrations to relevant data collected during the 2006 study as well as available treatment technology performance data in IWTT.

Evaluation of Direct Discharge Mercury Concentrations

EPA compared the 2014 mercury concentration data for direct discharging pulp and paper mills to the Form 2C median concentration identified during the 2006 detailed study and the Method 245.1 ML.

Table 4-43 summarizes the 2014 direct discharge mercury concentration data, including the minimum, median, and maximum concentrations and number of data points for the DMR and TRI data. As shown, the median concentrations for both the DMR and TRI data fall two orders of magnitude below the 2006 Form 2C median concentration and Method 245.1 ML. The maximum DMR concentration is only slightly above the Method 245.1 ML. The data suggest that mercury discharges from direct discharging mills are below treatable levels, consistent with information from the 2006 detailed study.

Table 4-43. Comparison of Pulp and Paper Mill 2014 Average Direct Discharge Mercury Concentration Data to 2006 Form 2C Data and the Method ML

Data Type	Number of Data Points[a]	Average Mercury Concentrations (µg/L)		
		Minimum	Median	Maximum
2014 Pulp and Paper Mill DMR Data	14	0.000411	0.00361	0.231
2014 Pulp and Paper Mill TRI Data	9	Non-detect	0.00397	0.007
2006 Form 2C Median Concentration for Mercury	**0.1 µg/L**			
Method 245.1 ML for Mercury	**0.2 µg/L**			

Source: (ERG, 2016; U.S. EPA, 2006a).

[a] The number of data points represents the number of outfalls, not mills. Some mills have more than one outfall.

Evaluation of Indirect Discharge Mercury Concentrations

The majority of pulp and paper mills are direct dischargers; therefore, the dataset is limited for indirect discharging mills. To evaluate indirect discharges of mercury, EPA compared current mercury concentrations in effluent from three mills to the Method 245.1 ML concentration for mercury. As shown in Table 4-44, two of the three average TRI concentrations fall below the Method 245.1 ML. One average concentration is the same order of magnitude but falls above the Method 245.1 ML. Consistent with the data for direct discharges, these limited data suggest that mercury discharges from indirect mills are generally below treatable levels.

Table 4-44. Comparison of Pulp and Paper Mill 2014 Average Indirect Discharge Mercury Concentration Data to the Method ML

Mill Name and Location	Average Mercury Concentration
Verso/Luke Paper Co., Luke, MD	0.0996 µg/L
Blandin Paper Co., Grand Rapids, MN	0.108 µg/L
Graphic Packaging International Inc., Macon, GA	0.25 µg/L
Method 245.1 ML for Mercury	**0.2 µg/L**

Source: (ERG, 2016; U.S. EPA, 2006a).

Treatment of Mercury in Pulp and Paper Wastewater

EPA queried the IWTT Database for performance data on the treatment of mercury, not specifically limiting its search to pulp and paper mills. Table 4-45 summarizes the identified treatment systems and their effectiveness. EPA did not identify any studies specifically citing mercury removal in the pulp and paper industry. However, other industries, such as petroleum refining and steam electric power generating, remove metals using granular-media filtration, constructed wetlands, membrane bioreactors, and adsorptive media. Two of the three studies with mercury removal data show mercury effluent concentrations of 0.0073 µg/L and <1 µg/L and removal efficiencies ranging from 62.9 to 92.5 percent. The 2014 median mercury concentrations identified during this review (0.00361 µg/L and 0.00397 µg/L, respectively) are similar to the concentrations identified from studies in IWTT. Therefore, the studies do not demonstrate the availability of technologies that can reduce mercury concentrations to below levels currently measured in pulp and paper mill discharges.

Table 4-45. Summary of Wastewater Treatment Technologies for Mercury in IWTT

Wastewater Treatment Technology (Order of Unit Processes)	Effluent Mercury Concentration (µg/L)[a]	Percent Removal	Industry	Treatment Scale	Reference
Granular-Media Filtration	0.0073	91.8%	Petroleum refining	Pilot	(Pulliam, et al., 2010)
Constructed Wetlands	NR	92.5%	Steam electric power generating	Pilot	(Morrison, et al., 2011)
Mechanical Pre-Treatment, Flow Equalization, Oil/Water Separation, Membrane Bioreactor, and Adsorptive Media	< 1	> 62.9%	Transportation equipment cleaning	Full	(Buckles, et al., 2007)

NR – Not Reported

[a] Some studies reported effluent concentration data in mg/L. EPA converted the data to µg/L to facilitate comparison with mill effluent mercury concentrations.

4.3.4.3 Evaluation of Manganese Discharge Concentrations

For this analysis, EPA compiled manganese concentration data for 14 pulp and paper mills; two from data reported on 2014 DMRs, 11 from mills reporting direct releases to TRI, and one from a mill reporting indirect releases to TRI in 2014. Per the methodology outlined in Section 2.1.4, EPA calculated the yearly average concentrations from these mills to use in subsequent analyses (ERG, 2016). EPA compared current discharge concentrations to relevant data collected during the 2006 study as well as available treatment technology performance data in IWTT. EPA also followed up with the two pulp and paper trade associations, AF&PA and NCASI, to gather additional information on sources, concentrations discharged, and treatment technologies for manganese, discussed below.

Evaluation of Direct Discharge Manganese Concentrations

EPA compared the 2014 manganese concentration data for direct discharging pulp and paper mills to the Form 2C median concentration identified during the 2006 detailed study and the Method 200.7 ML for manganese.

Table 4-46 summarizes the 2014 direct discharge manganese concentration data, including the minimum, median, and maximum concentrations and number of data points for the DMR and TRI data. As shown, the median concentrations for both the DMR and TRI data are two orders of magnitude above the Method 200.7 ML, but similar to the 2006 Form 2C median concentration. These data suggest that manganese may generally be present in discharges at concentrations that could be controlled by further treatment. This is consistent with information from the 2006 detailed study; however, at that time EPA concluded that manganese concentrations are frequently higher in mill intake than in mill effluent and that costs of treatment technologies targeting manganese make such technologies infeasible. Therefore, pollution control strategies for manganese, such as minimizing spent pulping liquor losses, may be the best approach for reducing manganese discharges from pulp and paper mills[32] (U.S. EPA, 2006a).

Table 4-46. Comparison of Pulp and Paper Mill 2014 Average Direct Discharge Manganese Concentration Data to 2006 Form 2C Data and the Method ML

Data Type	Number of Data Points[a]	Manganese Concentrations (ug/L)		
		Minimum	Median	Maximum
2014 Pulp and Paper Mill DMR Data	7[a]	17	160	840
2014 Pulp and Paper Mill TRI Data	11	0.0000339	740	2,200
2006 Form 2C Median Concentration for Manganese	**556 ug/L**			
Method 200.7 ML for Manganese	**2 ug/L**			

Source: (ERG, 2016; U.S. EPA, 2006a).
[a] The number of data points represents the number of outfalls, not mills. Some mills have more than one outfall.

[32] Additional pollution control strategies for manganese include dry disposal of green liquor dregs and lime mud, dry removal of soil (dirt) from logs prior to debarking and chipping, conversion from alum precipitation water treatment to reverse osmosis treatment, and minimizing paper machine losses (U.S. EPA, 2006a).

Evaluation of Indirect Discharge Manganese Concentrations

EPA obtained only one indirect discharge manganese concentration value from the pulp and paper mills contacted. Graphic Packaging International Inc., Macon, GA reported a concentration of 0.88 mg/L (880 ug/L), which is more than two orders of magnitude higher than the manganese Method 200.7 ML, 0.002 mg/L, but similar to the 2006 Form 2C median concentration. This data point is consistent with the results of the analysis of direct discharges, discussed above.

Additional Review of Manganese Discharges

As shown above, the median direct and indirect discharge manganese concentrations are two orders of magnitude above the Method 200.7 ML, but similar to the 2006 Form 2C median concentration, which suggest that manganese may generally be present in discharges at concentrations that could be controlled by further treatment. Therefore, EPA followed up with the pulp and paper trade associations to gather additional information on manganese sources, concentrations discharged, and treatment technologies.

The pulp and paper trade associations compiled manganese concentration data for pulp and paper mills from several data sources, including NCASI files, DMRs, Form 2C data, TRI, and NPRI. Table 4-47 presents the additional manganese concentration data for pulp and paper mills. EPA compared the additional concentration data to the Method 200.7 ML for manganese to provide a frame of reference for the magnitude of the discharges. EPA also compared the concentration data to ten times the Method 200.7 ML to assess whether the concentrations are generally at a level substantial enough for further treatment, presented in Table 4-47. Consistent with EPA's analysis of concentration data, the minimum concentrations across all datasets are above the ML, and the median concentrations across all datasets are generally at least an order of magnitude or more greater than ten times the ML for manganese.

Table 4-47. Comparison of Pulp and Paper Mill Manganese Effluent Concentration Data from Trade Associations to the MDL

Data Source	Reporting Year	Number of Mills	Manganese Concentrations (µg/L)		
			Minimum	Median	Maximum
NCASI Data	1998	8	17	NA	1,400
DMR[a]	2014	3	4	88	250
TRI[a]	2014	10	747	1,220	2,240
Form 2C	1997-2016	64	11	435	3,670
NPRI	2014	18	110	907	1,880
Method 200.7 ML for Manganese			**2 µg/L**		
10x Method 200.7 ML for Manganese			**20 µg/L**		

Source: (NCASI, 2017).

NA: Not applicable; trade associations did not provide the median concentration data for the NCASI data source.

[a] The 2014 DMR and TRI concentration data shown in Table 4-46 differs from the trade association data due to reviewing different subsets of data. For example, the trade associations reviewed the top ten mills with manganese releases in TRI in 2014 and multiplied the reported loads by available flow data to calculate concentrations, while EPA reviewed concentration data provided by a subset of mills contacted shown in Table 4-46.

EPA notes several assumptions and limitations of the data compiled by the trade associations that include (NCASI, 2017):

- For TRI and NPRI data, the trade association's review focused on mills with the highest reported discharge loads of each metal.
- Because facilities report total loads to TRI and NPRI, and flow data are not available in these datasets, the trade associations estimated concentrations for these facilities based on readily available NCASI data on effluent flow and the reported TRI and NPRI loads. The NCASI, DMR, and Form 2C data represent the full range of actual concentration data reported.
- DMR data were limited because few pulp and paper mill NPDES permits require monitoring of manganese.
- Form 2C data collection is informal and cannot be assumed to represent a cross-section of the industry.

EPA also reviewed sources and treatment information provided by the pulp and paper trade associations. According to the trade associations, manganese concentrations in mill discharges may result from (NCASI, 2017):

- Intake water
- Wood furnishes
- Energy generation (e.g., coal, oil)
- Processing additives (e.g., phosphoric acid, sulfuric acid, alum, dyes, ammonia polyphosphate, clay)
- Other raw materials used by the mill

A primary source of manganese is wood furnish, including virgin fiber (e.g., chips or sawdust), old corrugated containers, and recycled papers (e.g., newsprint, magazines, copy paper). The amount of manganese in wood furnishes varies by wood type and furnish source; however, overall manganese levels in wood furnishes reported in literature and datasets from trade associations range from 2,920 to 110,000 parts per billion (ppb) (or µg/L). Manganese may also result from coal- and oil-fired energy generation, which is relevant at mills with wet ash handling systems or mills using wet air pollution control devices that have a liquid purge (NCASI, 2017).

The trade associations also reviewed and provided information on intake water manganese concentrations, based on an evaluation of 2000 to 2015 data from EPA's Water Quality eXchange (WQX) for the Hydrologic Unit Codes (HUCs) from the closest upstream monitoring locations for mills with DMR, Form 2C, and/or TRI data. From this review, trade associations identified that median upstream ambient water manganese concentrations ranged from 5.6 to 320 µg/L and suggested that a focused study would be needed to evaluate whether intake water is a significant contributor to manganese concentrations in mill effluent (NCASI, 2017). Upstream ambient manganese concentrations reported by the trade associations are lower than, but on the same order of magnitude as, the median effluent concentrations reported in Table 4-47.

Treatment of Manganese in Mill Pulp and Paper Wastewater

According to the trade associations, sedimentation and biological secondary treatment are used in the pulp and paper industry and at POTWs to remove biochemical oxygen demand (BOD) and total suspended solids (TSS) (NCASI, 2017). Manganese may be incidentally removed through precipitation, adsorption, and biological uptake; however, pulp and paper mills do not operate treatment technologies dedicated to the removal of manganese. From their review of industry literature, trade associations identified that municipal treatment plants with primary and secondary treatment generally remove less than 50 percent of manganese (NCASI, 2017).

EPA also queried the IWTT Database for performance data on the treatment of manganese, not specifically limiting its search to pulp and paper mills. Table 4-48 summarizes the identified treatment systems and their effectiveness. EPA did not identify any studies specifically citing manganese removal in the pulp and paper industry. However, other industries, such as ore mining and dressing and petroleum refining, remove metals using biological treatment, advanced filtration, and ion exchange technologies. The reviewed studies reported manganese effluent concentrations ranging from less than 10 µg/L to 1,770 µg/L, and removal efficiencies ranging from 53.1 percent to 98.6 percent. The effluent concentrations identified from IWTT fall within the range of trade association median effluent data (88 µg/L to 1,220 µg/L) and are similar to the median 2014 DMR and TRI concentration data (160 µg/L and 740 µg/L, respectively). Therefore, the studies do not conclusively demonstrate that the available technologies can reliably reduce manganese concentrations to below levels currently measured in pulp and paper mill discharges.

Table 4-48. Summary of Wastewater Treatment Technologies for Manganese in IWTT

Parameter	Wastewater Treatment Technology (Order of Unit Processes)	Effluent Concentration (µg/L)[a]	Percent Removal	Industry	Treatment Scale	Reference
Manganese	Aerobic Fixed Film Biological Treatment, Chemical Precipitation, and Powdered Activated Carbon	150	53.1%	Metal finishing	Pilot	(Ahmad, et al., 2010)
	Chemical Precipitation, Dissolved Air Flotation, and Granular-Media Filtration	230	98.6%	Ore mining and dressing	Pilot	(Colic & Hogan, 2012)
	Membrane Bioreactor and Aeration	1,770	82.0%		Pilot	(Progress, et al., 2012)
	Constructed Wetlands	NR	92.5%	Steam electric power generating	Pilot	(Morrison, et al., 2011)
Manganese, total	Membrane Filtration, Ion Exchange, and Reverse Osmosis	<10	> 83.3%	Petroleum refining	Pilot	(Ginzburg & Cansino, 2009)
	Membrane Bioreactor	10	NR	Canned and Preserved Fruits and Vegetables Processing	Pilot	(Riedel, et al., 2015)
	Anaerobic Digestion, Membrane Bioreactor	100	NR		Pilot	

[a] Some studies reported effluent concentration data in mg/L. EPA converted the data to µg/L to facilitate comparison with mill effluent manganese concentrations.

NR – Not Reported

4.3.4.4 Summary of Permit Reviews and Information Obtained from States Regarding Discharges of Lead, Mercury, and Manganese

As part of this review, EPA contacted two state permitting authorities, the Wisconsin Department of Natural Resources (WI DNR) and the Connecticut Department of Energy and Environmental Protection (CT DEEP), that have a high proportion of pulp and paper mills with DMR discharges of lead, mercury, and/or manganese. EPA made these contacts to help inform its understanding of the pollutant discharges. Specifically, EPA collected additional information on the development of permit limits.

When a mill submits a permit application with lead, mercury, or manganese concentration data, in addition to applying any relevant technology-based limitations (in this case, any applicable Pulp and Paper ELGs) both states will calculate a reasonable potential for the pollutant to be present in the wastewater at a level requiring a water quality-based permit limit. The water quality-based permit limit is calculated using water quality criteria (Mauger, 2016; Zimmerman, 2016).

In Wisconsin, the water quality standards for lead include acute toxicity criteria (ATC), chronic toxicity criteria (CTC), and human threshold criteria (HTC). The water quality standards for mercury include ATC, CTC, HTC, and a wildlife criterion. The mercury wildlife criterion is the most stringent, so most permit limits are based on this value. Wisconsin does not have a water quality standard for manganese, but they do have a drinking water standard. If a mill has 11 or more detections of a pollutant in their permit application sampling data, WI DNR performs a reasonable potential analysis. If the statistical value calculated is greater than the water quality standard, the pollutant limit will be added to the mill permit. If the application has fewer than 11 detections, the state will determine if the average of the available concentration data is greater than one-fifth of the water quality standard, whereupon the pollutant limit will be added to the mill permit (Zimmerman, 2016).

The WI DNR contact indicated that most of the rivers in Wisconsin have high background mercury concentrations and that most pulp and paper mill mercury discharges result from the influent water; no mercury is added during the pulp and paper manufacturing process (Zimmerman, 2016).

The CT DEEP contact did not provide details on the water quality standards for lead, mercury, or manganese in Connecticut (Mauger, 2016).

The CT DEEP contact provided mill permits and fact sheets for three pulp and paper mills, and the Wisconsin DNR contact provided mill permits and fact sheets for four pulp and paper mills. Table 4-49 presents a summary of the permit information for these seven pulp and paper mills, including the lead, mercury, and manganese permit limits. As shown, only one mill has permit limits for lead, two mills have permit limits for mercury, and no mills have permit limits for manganese, although three mills have manganese monitoring requirements.

Table 4-49. Summary of Permit Information for Connecticut and Wisconsin Pulp and Paper Mills

NPDES ID	Mill Name	Mill Location	Lead Limits: Outfall Number	Lead Limits: Monthly Average Limit (mg/L)	Lead Limits: Daily Max Limit (mg/L)	Mercury Limits: Outfall Number	Mercury Limits: Monthly Average Limit (mg/L)	Mercury Limits: Daily Max Limit (mg/L)	Manganese Limits: Outfall Number	Manganese Limits: Monthly Average Limit (mg/L)	Manganese Limits: Daily Max Limit (mg/L)
CT0026476	Algonquin Power Cogeneration Facility	Windsor Locks	001-1, 002-1	Monitoring only	None	None	None	None	001-1, 002-1	Monitoring only	None
CT0000434	Ahlstrom Nonwovens	Windsor Locks	006-1, 008-1	Monitoring only	None	None	None	None	002-1, 003-1, 003A, 004-1, 005-1	Monitoring only	None
CT0003212	Kimberly-Clark	New Milford	002-1	0.00675	0.0167	None	None	None	None	None	None
WI0037991	Stora Enso North America Water Quality Center	Wisconsin Rapids, WI	None	None	None	022	None	0.000038	None	None	None
WI0002810	Packaging Corp of America	Tomahawk, WI	None	None	None	003	None	0.000042	None	None	None
WI0003620	Domtar	Point Edwards, WI	005	Monitoring only[a]	None	013	None	0.000018	005	Monitoring Only[a]	None
WI0003212	Flambeau River Papers	Park Falls, WI	None	None	None	001	Monitoring Only	None	None	None	None

Source: (CT DEEP, 2009, 2011a, 2011b; WI DNR, 2010a, 2010b, 2013, 2015)

[a] The permit lists monitoring requirements for dissolved lead and dissolved manganese.

4.3.5 Pulp & Paper Category Review of Hydrogen Sulfide Discharges

For this analysis, EPA evaluated 2014 TRI data to identify any changes in releases from those reported in the 2013 TRI data (which EPA evaluated for the 2015 Annual Review). As shown in Table 4-50, hydrogen sulfide releases reported to TRI have slightly, but consistently increased from 2012 to 2014. EPA reviewed the 2014 TRI data in more detail and identified that five mills account for approximately 70 percent of the reported hydrogen sulfide releases, shown in Table 4-51.

Table 4-50. Summary of 2012-2014 TRI Hydrogen Sulfide Releases

Year	Direct Releases (pounds)	Direct TWPE	Indirect Releases (pounds)	Indirect TWPE	Total Releases (pounds)	Total TWPE
2012	408,000	1,140,000	3,760	10,500	412,000	1,150,000
2013	419,000	1,170,000	4,680	13,100	424,000	1,190,000
2014	437,000	1,220,000	2,430	6,790	440,000	1,230,000

Source: Water Pollutant Loading Tool
Note: Sums of individual values may not equal the total presented, due to rounding.

Table 4-51. Top Mills Reporting 2014 TRI Hydrogen Sulfide Releases

Mill Name	Mill Location	Pounds of Pollutant Released	Pollutant TWPE	Percent of Category TWPE
Georgia-Pacific Monticello	Monticello, MS	141,000	394,000	32.0%
Alabama River Cellulose LLC	Perdue Hill, AL	49,300	138,000	11.2%
Brunswick Cellulose LLC	Brunswick, GA	46,900	131,000	10.7%
Rayonier Performance Fibers Jesup Mill	Jesup, GA	40,800	114,000	9.3%
Georgia Pacific Cedar Springs LLC	Cedar Springs, GA	31,700	88,600	7.2%
All other Pulp and Paper Category mills reporting hydrogen sulfide releases (90 additional mills).		130,000	365,000	29.6%
Total		**440,000**	**1,230,000**	**100%**

Source: *TRILTOutput2014_v1*
Note: Sums of individual values may not equal the total presented, due to rounding.

As mentioned above, NCASI indicated during the 2015 Annual Review that it was developing a new sampling system that might enable more accurate measurement of hydrogen sulfide, thereby reducing overestimations reported to TRI. As part of the current review, EPA contacted the pulp and paper trade associations, AF&PA and NCASI, to discuss progress on the sampling system, as well as an apparent further increase in releases of hydrogen sulfide. NCASI reported that they have not yet updated sampling methods (Schwartz & Wiegand, 2016). See the 2015 Annual Review Report for further details on NCASI's sampling methods and EPA's review of hydrogen sulfide releases (U.S. EPA, 2016a).

AF&PA and NCASI also contacted the top mills reporting 2014 TRI hydrogen sulfide releases, shown in Table 4-51, to further understand the releases. Georgia-Pacific, which owns four of the mills listed in Table 4-51, confirmed that all hydrogen sulfide release calculations for the four mills resulted from wastewater sampling and measurements of total sulfide in the wastewater. However, the original calculations did not take into account the effluent pH and resulting proportion that hydrogen sulfide that would be present in the aqueous form at the measured effluent pH. Georgia-Pacific updated the hydrogen sulfide calculations for all four mills based on this observation. Additionally, the Georgia-Pacific Monticello mill confirmed that the 2014 TRI hydrogen sulfide release mistakenly used a concentration from sampling that occurred in 2011 (Schwartz & Wiegand, 2016). Table 4-52 presents revised pounds of released hydrogen sulfide and TWPE, reflecting corrected data provided by Georgia-Pacific.

AF&PA and NCASI also contacted Rayonier Performance Fibers in Jesup, GA. The mill identified a mathematical error in the hydrogen sulfide calculations that caused the reported discharges to be off by a factor of ten (Schwartz & Wiegand, 2016). Table 4-52 presents revised pounds and TWPE for the Rayonier Performance Fibers mill.

These corrections to the 2014 hydrogen sulfide data decrease the total hydrogen sulfide TWPE for the Pulp and Paper Category from 1,230,000 to 580,000. This new information suggests that other hydrogen sulfide releases reported to TRI may be overestimated, potentially substantially.

Table 4-52. Revised Data for Top Mills Reporting 2014 TRI Hydrogen Sulfide Releases

Mill Name	Mill Location	Pounds of Pollutant Released	Pollutant TWPE	Percent of Category TWPE
Georgia-Pacific Monticello	Monticello, MS	8,190	22,900	4.0%
Alabama River Cellulose LLC	Perdue Hill, AL	39,500	111,000	19.1%
Brunswick Cellulose LLC	Brunswick, GA	7,370	20,600	3.6%
Rayonier Performance Fibers Jesup Mill	Jesup, GA	14,700	41,200	7.1%
Georgia Pacific Cedar Springs LLC	Cedar Springs, GA	7,180	20,100	3.5%
All other Pulp and Paper Category mills reporting hydrogen sulfide releases (90 additional mills).		130,000	365,000	62.9%
Total		**207,000**	**580,000**	**100%**

Source: *TRILTOutput2014_v1*
Note: Sums of individual values may not equal the total presented, due to rounding.

4.3.6 Pulp and Paper Category NPRI Analysis Introduction

EPA evaluated the utility of using data from Canada's NPRI to identify potential additional pollutants that may be present in industrial wastewater discharges from mills in the U.S., as indicated by their presence in industrial wastewater discharges from mills in Canada. Section 2.2 of this report provides a general overview of the NPRI analysis and methodology. This section presents EPA's review of the NPRI data specific to the Pulp and Paper Category.

4.3.6.1 NPRI Analysis Overview

EPA compared water release data in TRI to data reported in Canada's NPRI for the Pulp and Paper Category to identify pollutants reported in NPRI, but not captured in the TRI. For those pollutants, EPA compared the reporting requirements between NPRI and TRI to understand the impact of any reporting differences (e.g., are the thresholds for reporting similar, do groups of reported chemicals include the same set of individual compounds, etc.) and further evaluated the potential for releases of these pollutants in the U.S.

For this analysis, EPA evaluated 2013 TRI and NPRI data, the most recent data available in both datasets at the time of review. EPA processed the data as described in Section 2.2 to obtain the relevant industry category, pollutant names, mill counts, and water releases for each of the datasets. For mills associated with the Pulp and Paper Category, EPA compared the list of pollutants with water releases reported to NPRI and TRI.

In 2013, 69 Canadian pulp and paper mills reported water release data for 41 pollutants to NPRI, while 226 U.S. pulp and paper mills reported water release data for 43 pollutants to TRI. As shown in Table 4-53, EPA identified 15 pollutants reported to NPRI that were not reported to TRI by pulp and paper mills in 2013. Six of the 15 pollutants are not included on the EPCRA Section 313 Chemical List for 2013 (2013 List of TRI Chemicals); therefore, facilities are not required to report releases for these pollutants (U.S. EPA, 2014c).

Table 4-53. Pollutants Reported by Pulp and Paper Mills to 2013 NPRI but not to 2013 TRI

Pollutant Name	On 2013 List of TRI Chemicals[a]	Number of NPRI Pulp and Paper Mills Reporting Pollutant Release to Water	Percentage of all NPRI Pulp and Paper Mills Reporting Water Release
Benzene	Y	2	3%
Benzo(e)pyrene	N	1	1%
Benzo(g,h,i)perylene	Y	1	1%
Cadmium (and its compounds)	Y	50	72%
Chlorine	Y[b]	3	4%
Chlorine dioxide	Y[b]	1	1%
Isopropyl alcohol	Y	1	1%
Methyl ethyl ketone	N[c]	5	7%
Methyl isobutyl ketone	Y	5	7%
Perylene	N	1	1%
Phenanthrene	Y	4	6%
Phosphorus (total)	N[d]	54	78%
Pyrene	N	8	12%
Selenium (and its compounds)	Y	23	33%
Total reduced sulfur (TRS)	N	17	25%

Sources: *NPRICompare2013; TRILTOutput2013_v1*; (U.S. EPA, 2014c).

a Refers to pollutants included in the 2013 List of TRI Chemicals, regardless of whether water releases were actually reported for the pollutant.

b Chlorine and chlorine dioxide are gaseous forms of chlorine, and not expected to be released to water under typical conditions (U.S. EPA, 1998).

c Methyl ethyl ketone was removed from the List of TRI Chemicals in 2003 (U.S. EPA, 2015).

d The 2013 List of TRI Chemicals only includes Phosphorus (yellow or white). Yellow and white phosphorus, both allotropes of elemental phosphorus, are hazardous pollutants that spontaneously ignite in air. During the 2006 Annual Review, EPA identified that mills were incorrectly reporting discharges of total phosphorus (i.e., the phosphorus portion of phosphorus-containing compounds) as phosphorus (yellow or white) (U.S. EPA, 2006b). Therefore, EPA concluded that it was appropriate to exclude all phosphorus (yellow or white) discharges reported to TRI, and has made such adjustments to the data, beginning with the 2011 Annual Review (U.S. EPA, 2012). Total phosphorous (as reported in NPRI) is not included in the current List of TRI chemicals (for reporting year 2015).

4.3.6.2 NPRI Pollutant Analysis

EPA identified 15 pollutants reported to NPRI in 2013 that were not reported to TRI. EPA prioritized and further reviewed those pollutants reported by more than 20 percent of pulp and paper mills reporting water releases to NPRI. EPA performed a more in-depth analysis for the following pollutants:

- Cadmium and cadmium compounds (Cadmium)

- Total Phosphorus
- Selenium and selenium compounds (Selenium)
- Total reduced sulfur

Review of Cadmium Discharges

Cadmium is a TRI-listed pollutant; however, no U.S. pulp and paper mills reported cadmium releases in TRI in 2013. EPA evaluated the reporting requirements of the two programs and identified that the TRI reporting thresholds for cadmium are much higher than those of NPRI, which likely explains the discrepancy in the number of reporting mills between the two inventories. Both inventories base reporting thresholds on the amount of pollutant manufactured, processed, or otherwise used at the mill, not the amount discharged. In NPRI, cadmium is classified under Threshold Category 1B (alternate threshold substances), with a mass reporting threshold of 5 kilograms (kg) manufactured, processed, or otherwise used, and a concentration threshold of 0.1 percent by weight (Environment Canada, 2015). In TRI, the mass threshold is 25,000 pounds manufactured or processed, or 10,000 pounds otherwise used (U.S. EPA, 2014d).

EPA compared the magnitude of the cadmium releases reported in NPRI to available 2013 DMR data for cadmium. The 2013 NPRI cadmium releases ranged from 55 to 605 pounds per year for the top ten facilities reporting cadmium releases to NPRI (ranked by total pounds of cadmium released), as shown in Table 4-54. The cadmium discharges reported by the three pulp and paper mills with DMR discharges range from less than 1 to 50 pounds, as shown in Table 4-55. One mill accounts for 95 percent of the 2013 DMR cadmium discharges from pulp and paper mills. In general, the magnitude of cadmium releases in the 2013 NPRI is higher than the 2013 DMR cadmium loadings.

EPA considers it probable that no pulp and paper mills reported cadmium releases to TRI in 2013 because the reporting threshold was high (and higher than the NPRI reporting threshold).

Table 4-54. Top 2013 Pulp and Paper Mills Reporting Cadmium Releases to NPRI

Mill Name	Mill Location	Pounds of Pollutant Released [a]
Edmundston Pulp Mill	Edmundston, NB	605
Neucel Specialty Cellulose (Sfo)	Port Alice, BC	179
Howe Sound Pulp And Paper Mill	Port Mellon, BC	133
Kamloops Mill (Sfo)	Kamloops, BC	120
Irving Pulp & Paper	Saint John, NB	108
Northwood Pulp Mill	Prince George, BC	105
Slave Lake Pulp - Slave Lake	Slave Lake, AB	95.0
Hinton Pulp	Hinton, AB	83.6
Thunder Bay Operations	Thunder Bay, ON	56.2
Papiers De Publication Kruger Inc. Usine De Trois-Rivières	Trois-Rivières, QC	55.6
All other Pulp and Paper Category mills reporting cadmium releases (40 additional mills)		875
Total		**2,420**

Source: (Environment Canada, 2014).

[a] All NPRI cadmium (and its compounds) releases were reported as direct releases.

Table 4-55. Top 2013 Pulp and Paper Mills Reporting Cadmium Discharges on DMRs

Mill Name	Mill Location	Pounds of Pollutant Discharged
Rocktenn - Fernandina Beach Mill	Fernandina Beach, FL	48.8
Meadwestvaco Custom Papers Laurel Mill	Lee, MA	1.47
Monadnock Paper Mills	Bennington, NH	0.59
Total		**51.1**

Source: *DMRLTOutput2013_v1*.

As a next step to further understand cadmium discharges, EPA reviewed information from the 2006 detailed study. During the 2006 detailed study, EPA analyzed metals discharges, including discharges of cadmium, from pulp and paper mills. For the study, EPA collected information about the concentrations of metals in pulp and paper mill discharges from NPDES Permit Renewal Application (Form 2C) data and compared the concentrations to analytical method MLs. EPA concluded that cadmium concentrations were below the method MLs, and that intake concentrations of cadmium are generally similar to or higher than effluent concentrations (U.S. EPA, 2006a).

To further understand the sources, concentrations discharged, and wastewater treatment of cadmium in pulp and paper mill wastewaters, EPA contacted and reviewed additional information on this pollutant provided by the pulp and paper trade associations. Similar to the information provided for manganese, the pulp and paper trade associations compiled cadmium concentration data for pulp and paper mills from several data sources, including NCASI files, DMRs, Form 2C data, TRI, and NPRI. Section 4.3.4.3 presents the assumptions and limitations of the data compiled by the trade associations.

Table 4-56 presents the cadmium concentration data for pulp and paper mills compiled by the trade associations. Five out of eleven mills submitted zero or below detection limit cadmium concentrations on their 2014 DMRs. No pulp and paper mills reported cadmium releases to TRI in 2014[33] (NCASI, 2017). For comparison, Table 4-56 also presents the Method 200.7 ML for cadmium and ten times the ML. As shown, the median concentrations are below the ML (and below 10 times the ML). The maximum concentrations are all below 10 times the ML.

[33] EPA identified that the TRI reporting thresholds for cadmium are much higher than NPRI reporting thresholds for cadmium, which may explain the discrepancy in reporting rates.

Table 4-56. Comparison of Pulp and Paper Mill Cadmium Effluent Concentration Data from Trade Associations to the MDL

Data Source	Reporting Year	Number of Mills	Cadmium Concentrations (µg/L)		
			Minimum	Median	Maximum
NCASI Data	1998	8	0.14	NA	1.70
DMR	2014	11	0[a]	0.44	4.27
Form 2C	1997-2016	21	0.10	0.50	2.00
NPRI	2014	18	0.22	1.19	16.8
Method 200.7 ML for Cadmium			**2 µg/L**		
10x Method 200.7 ML for Cadmium			**20 µg/L**		

Source: (NCASI, 2017)
NA: Not applicable; trade associations did not provide the median concentration for the NCASI data source.
[a] Two mills reported zero values; no information was available regarding the detection limit for these mills. Three mills reported values below detection limits.

EPA also reviewed sources and treatment information provided by the pulp and paper trade associations. According to the trade associations, cadmium concentrations in mill discharges may result from (NCASI, 2017):

- Intake water
- Wood furnishes
- Processing additives (e.g., phosphoric acid, sulfuric acid, ammonia polyphosphate)
- Other raw materials used by the mill

The trade associations noted that two literature sources identified wood chips as accounting for 83.6 percent and 93.4 percent of the cadmium discharges in pulp and paper industry wastewater (NCASI, 2017).

Similar to the review of intake water for manganese concentrations discussed in Section 4.3.4.3, trade associations evaluated cadmium data from EPA's WQX for a subset of mills. From this review, trade associations identified that median upstream ambient water cadmium concentrations were less than 0.25 µg/L. Trade associations noted that a focused study would be needed to make a definitive conclusion on whether intake water is a significant contributor to cadmium concentrations in mill effluent (NCASI, 2017). Upstream ambient manganese concentrations reported by the trade associations are lower than, but on the same order of magnitude as the median effluent concentration values shown in Table 4-56.

According to the pulp and paper trade associations, pulp and paper mills do not operate treatment technologies that specifically target removal of cadmium. However, cadmium may be incidentally removed through precipitation, adsorption, and biological uptake processes during primary or secondary treatment. From the review of industry literature, trade associations identified that municipal treatment plants with primary and secondary treatment generally remove more than 50 percent of cadmium from wastewater (NCASI, 2017). Trade associations identified that one mill collecting data between 1998 and 2002 achieved cadmium concentrations of less than 1 µg/L using aerated lagoon biological treatment, however, no removal efficiencies could be calculated. One trade association conducted bench-scale testing to evaluate whether tertiary solids treatment for control of metals would increase cadmium removal from mill effluent. The technologies evaluated did remove more than 90 percent of cadmium spiked into a wastewater sample. However, no tests were conducted using native concentrations of cadmium (NCASI, 2017).

EPA also queried the IWTT Database for performance data on the treatment of cadmium, not specifically limiting its search to pulp and paper mills. Table 4-57 summarizes the identified treatment systems and their effectiveness. EPA did not identify any studies specifically citing cadmium removal in the pulp and paper industry. However, other industries, such as ore mining and dressing and metal finishing, remove metals using membrane filtration, secondary biological treatment, adsorptive media, and electrocoagulation. The reviewed studies reported cadmium effluent concentrations ranging from 0.85 µg/L to 130 µg/L, and removal efficiencies ranging from 71.2 percent to 99.9 percent. The median concentrations from the trade association effluent data (ranging from 0.44 µg/L and 1.19 µg/L) are on the lower end of the effluent concentration range identified from IWTT. Therefore, the studies do not demonstrate the availability of technologies that can reduce cadmium concentrations to below levels currently measured in pulp and paper mill discharges.

Table 4-57. Summary of Wastewater Treatment Technologies for Cadmium

Wastewater Treatment Technology (Order of Unit Processes)	Effluent Cadmium Concentration (µg/L) [a]	Percent Removal	Industry	Treatment Scale	Reference
Chemical Precipitation, Dissolved Air Flotation, Granular-Media Filtration	0. 85	99.8%	Ore mining and dressing	Pilot	(Colic & Hogan, 2012)
Membrane Bioreactor, Aeration	2.4	98.1%		Pilot	(Progress, et al., 2012)
Electrocoagulation	NR	75%	Metal finishing	Pilot	(Firouzi, et al., 2009a)
	28	78.5%			(Firouzi, et al., 2009b)
	12	98.1%			
	130	97.2%			
	NR	99.9%			
Electrocoagulation, Membrane Filtration	4	98.6%			
Aerobic Fixed Film Biological Treatment, Chemical Precipitation, Powdered Activated Carbon	< 1	NR		Pilot	(Ahmad, et al., 2010)

Table 4-57. Summary of Wastewater Treatment Technologies for Cadmium

Wastewater Treatment Technology (Order of Unit Processes)	Effluent Cadmium Concentration (µg/L) [a]	Percent Removal	Industry	Treatment Scale	Reference
Bag & Cartridge Filtration, Oil/Water Separation, Flow Equalization, Membrane Filtration	< 2	NR		Pilot	(Pugh, et al., 2014)
Mechanical Pre-Treatment, Flow Equalization, Oil/Water Separation, Membrane Bioreactor, Adsorptive Media	< 3	> 71.2%	Transportation equipment cleaning	Full	(Buckles, et al., 2007)

[a] Some studies reported effluent concentration data in mg/L. EPA converted the data to µg/L to facilitate comparison with mill effluent cadmium concentrations.

NR – Not Reported

Review of Total Phosphorus Discharges

No pulp and paper mills reported total phosphorus releases to TRI in 2013. However, TRI does include one form of phosphorus on the 2013 List of TRI Chemicals, known as yellow or white phosphorus (U.S. EPA, 2014c). Historically, as part of its annual review process EPA excludes yellow or white phosphorus reported to TRI from its analyses because this elemental form of phosphorus is insoluble in water and is not the same form of phosphorus commonly measured in wastewater (U.S. EPA, 2012). According to NPRI reporting guidance, total phosphorus does not include yellow or white phosphorus; NPRI includes yellow or white phosphorus as a separate pollutant (Environment Canada, 2015).

EPA compared the magnitude of the total phosphorus releases reported to NPRI to available 2013 DMR data for total phosphorus. The 2013 NPRI total phosphorus releases ranged from 67,900 to 323,000 pounds per year, as shown in Table 4-58, and the 2013 DMR total phosphorus discharges ranged from 53,600 to 215,000 pounds, as shown in Table 4-59, for the top ten facilities reporting total phosphorus releases to NPRI or DMR, respectively (ranked by total pounds of total phosphorus released). These top ten mills account for approximately 70 percent of the total 2013 DMR total phosphorus discharges reported by pulp and paper mills. In general, the magnitude of total phosphorus releases in the 2013 NPRI is similar to the 2013 DMR total phosphorus loadings.

Though several mills report total phosphorous discharges on DMRs, phosphorus does not have limitations under the Pulp and Paper ELGs. In addition, EPA has not previously reviewed total phosphorous discharges for the pulp and paper industry as part of recent annual reviews. Total phosphorous does not have an associated toxic weighting factor and subsequently does not appear in EPA's TRA. See Section 2 of EPA's 2015 Annual Review Report for more information on toxic weighting factors and EPA's TRA (U.S. EPA, 2016a).

Table 4-58. Top 2013 Pulp and Paper Mills Reporting Total Phosphorus Releases to NPRI

Mill Name	Mill Location	Direct Pounds of Pollutant Released	Indirect Pounds of Pollutant Released	Total Pounds of Pollutant Released
Edmundston Pulp Mill	Edmundston, NB	323,000	0	323,000
Thunder Bay Operations	Thunder Bay, ON	97,500	0	97,500
Dryden Mill	Dryden, ON	96,900	0	96,900
Alberta-Pacific Forest Industries Inc.	County of Athabasca, AB	88,700	0	88,700
Kamloops Mill (Sfo)	Kamloops, BC	88,100	0	88,100
Corner Brook Pulp And Paper	Corner Brook, NL	81,700	0	81,700
Northwood Pulp Mill	Prince George, BC	78,400	0	78,400
Neucel Specialty Cellulose (Sfo)	Port Alice, BC	73,900	0	73,900
Prince George Pulp and Paper and Intercontinental Pulp Mills	Prince George, BC	69,500	0	69,500
Mackenzie Pulp Mill	MacKenzie, BC	67,900	0	67,900
All other Pulp and Paper Category mills reporting total phosphorus releases (44 additional mills)		1,050,000	15,800	1,070,000
Total		**2,120,000**	**15,800**	**2,130,000**

Source: (Environment Canada, 2014).
Note: Mills report pounds of pollutant released directly to surface waters or indirectly to POTWs.

Table 4-59. Top 2013 Pulp and Paper Mills Reporting Total Phosphorus Discharges on DMRs

Mill Name	Mill Location	Pounds of Pollutant Discharged
Georgia-Pacific - Crossett Plywood/Studmill Complex	Crossett, AR	215,000
Clearwater Paper Corp.	Lewiston, ID	191,000
Boise White Paper, LLC	International Falls, MN	121,000
International Paper-Eastover Mill	Eastover, SC	104,000
International Paper Franklin Mill	Franklin, VA	104,000
International Paper Company	Riegelwood, NC	92,400
Packaging Corp. of America	Tomahawk, WI	80,500
Blue Ridge Paper Products, Inc. (dba Evergreen Packaging)	Canton, NC	61,000
Resolute Forest Products Catawba Operations	Catawba, SC	57,500
Domtar Paper Company, LLC	Plymouth, NC	53,600
All other Pulp and Paper Category mills reporting total phosphorus releases (59 additional mills)		490,000
Total		**1,570,000**

Source: DMRLTOutput2013_v1

To further understand the sources and treatment of total phosphorus in pulp and paper mill wastewaters, EPA contacted and reviewed additional information on this pollutant provided by the pulp and paper trade associations. According to the trade associations, pulp and paper mill process wastewaters are generally nutrient deficient relative to what is needed for effective biological treatment. Therefore, mills often add supplemental forms of phosphorus to ensure effective biological treatment. Mills optimize supplemental addition of phosphorus to minimize residuals in effluent, but optimization strategies are dependent on several factors, including treatment type and configuration, and other effluent quality targets such as BOD and TSS. Phosphorus may also enter process wastewater through raw materials, intake water, and some process additives such as bleaching chemicals and defoamers (NCASI, 2016).

According to the trade associations, few pulp and paper mills operate treatment systems for removing residual nutrients from biologically treated effluents due to the prohibitive cost of these systems. Pulp and paper mills with low phosphorus permit limits generally operate activated sludge treatment (AST) for biological treatment minimization in conjunction with one or more of the following technologies: equalization or stabilization basin; tertiary flotation, mechanical clarification, or filtration; and chemical precipitation. Activated sludge basins (ASBs) are an alternative biological treatment method, however they are less efficient at phosphorus removal than AST. Other emerging nutrient treatment methods available to pulp and paper mills include chemical phosphorus removal, a biofilm activated sludge (BAS) process (consisting of a moving-bed biofilm reactor followed by an AST), AST with nitrogen fixation, chemical precipitation with enhanced solids removal, and constructed wetlands treatment (NCASI, 2016).

Review of Selenium Discharges

Selenium is a TRI-listed pollutant; however, no U.S. pulp and paper mills reported selenium releases in TRI in 2013. EPA evaluated the reporting requirements between the two programs and identified that the TRI reporting thresholds for selenium are much higher than those of NPRI, which likely explains the discrepancy in the number of reporting mills between the two inventories. Both inventories base reporting thresholds on the amount manufactured, processed, or otherwise used at the mill, not the amount discharged. In NPRI, selenium is classified under Threshold Category 1B (alternate threshold substances) with a mass reporting threshold of 100 kg manufactured, processed, or otherwise used, and a concentration threshold of 0.000005 percent by weight (Environment Canada, 2015). In TRI, the mass threshold is 25,000 pounds manufactured or processed or 10,000 pounds otherwise used (U.S. EPA, 2014d).

EPA compared the magnitude of the selenium releases reported in NPRI to available 2013 DMR data for selenium. The 2013 NPRI selenium releases ranged from 20 to 285 pounds per year for the top ten facilities reporting selenium releases to NPRI (ranked by total pounds of selenium released), as shown in Table 4-60. The selenium discharges reported by the two pulp and paper mills with DMR discharges are both less than one pound, as shown in Table 4-61. In general, the magnitude of selenium releases in the 2013 NPRI is higher than the 2013 DMR selenium loadings.

EPA considers it probable that no pulp and paper mills reported selenium releases to TRI in 2013 because the reporting threshold was high (and higher than the NPRI reporting threshold).

Table 4-60. Top 2013 Pulp and Paper Mills Reporting Selenium Releases to NPRI

Mill Name	Mill Location	Pounds of Pollutant Released [a]
AV Terrace Bay	Terrace Bay, ON	285
Harmac Pacific Operations	Nanaimo, BC	236
Neucel Specialty Cellulose (Sfo)	Port Alice, BC	158
Northwood Pulp Mill	Prince George, BC	127
Dryden Mill	Dryden, ON	111
Edmundston Pulp Mill	Edmundston, NB	108
Usine De Brompton, Sherbrooke	Sherbrooke, QC	45.2
Usine Laurentide	Grand-Mère, QC	29.5
Kapuskasing Operations	Kapuskasing, ON	27.7
Papiers De Publication Kruger Inc. Usine De Trois-Rivières	Trois-Rivières, QC	23.8
All other Pulp and Paper Category mills reporting selenium releases (13 additional mills)		88.3
Total		**1,240**

Source: (Environment Canada, 2014).

[a] All NPRI selenium releases were reported as direct releases.

Table 4-61. Top 2013 Pulp and Paper Mills Reporting Selenium Discharges on DMRs

Mill Name	Mill Location	Pounds of Pollutant Discharged
Molded Pulp Mill ISW	Red Bluff, CA	0.55
Fibrek Recycling US Inc-Fairmont Div	Fairmont, WV	0.404
Total		**0.954**

Source: *DMRLTOutput2013_v1*

EPA did not analyze discharges of selenium as part of the 2006 detailed study because selenium was not among the ten pollutants with the highest TWPE, based on the 2002 DMR and TRI data (U.S. EPA, 2006a). Therefore, to further understand the sources, concentrations discharged, and treatment of selenium in pulp and paper mill wastewaters, EPA contacted and reviewed additional information on this pollutant provided by the pulp and paper trade associations. Similar to the information provided for manganese and cadmium, the pulp and paper trade associations compiled selenium concentration data for pulp and paper mills from several data sources, including NCASI files, DMRs, Form 2C data, TRI, and NPRI. Section 4.3.4.3 presents the assumptions and limitations of the data compiled by the trade associations.

Table 4-62 presents the selenium concentration data from pulp and paper mills compiled by trade associations. Two out of three mills submitted below detection limit selenium concentrations on their 2014 DMRs. No pulp and paper mills reported selenium releases to TRI in 2014[34] (NCASI, 2017). For comparison, Table 4-62 also presents the Method 200.7 ML for selenium and ten times the ML. As shown, all concentrations presented in the table are below the ML (and below 10 times the ML).

[34] EPA identified that the TRI reporting thresholds for selenium are much higher than NPRI reporting thresholds for selenium, which may explain the discrepancy in reporting rates.

Table 4-62. Comparison of Pulp and Paper Mill Selenium Effluent Concentration Data from Trade Associations to the MDL

Data Source	Reporting Year	Number of Mills	Selenium Concentrations (µg/L)		
			Minimum	Median	Maximum
NCASI Data	1998	9	BDL	NA	6.6
DMR	2014	3	BDL	NA	4.72
Form 2C	1997-2016	8	1.2	3.2	37.0
NPRI	2014	11	0.22	1.49	3.90
Method 200.7 ML for Selenium			**50 µg/L**		
10x Method 200.7 ML for Selenium			**500 µg/L**		

Source: (NCASI, 2017)
NA: Not applicable; trade associations did not provide these data.
BDL: Below detection limit

EPA also reviewed sources and treatment information provided by the pulp and paper trade associations. According to the trade associations, selenium concentrations in mill discharges may result from (NCASI, 2017):

- Wood furnishes
- Processing additives (e.g., phosphoric acid, sulfuric acid)
- Other raw materials used by the mill

The trade associations reviewed data showing that selenium was detected in 10 of 26 wood furnish samples, at levels ranging from 30 µg/L to 240 µg/L. Selenium has been detected in process additives such as phosphoric acid and sulfuric acid (NCASI, 2017).

The trade associations also evaluated intake water for selenium from EPA's WQX, similar to the intake water review for manganese and cadmium. From this review, trade associations identified that median upstream ambient water selenium concentrations were at or under the detection limit for all 117 measurements (NCASI, 2017). These data suggest that intake water is not a source of selenium in mill effluent.

Trade associations conducted a literature review for selenium removal at pulp and paper mills and identified that biological treatment is a common option for selenium removal in the mining and petroleum industries. While pulp and paper mills do not operate treatment technologies that specifically target the removal of selenium, trade associations suggested that it may be incidentally removed during primary and secondary treatment through precipitation, adsorption, or biological processes (NCASI, 2017).

EPA also queried the IWTT Database for performance data on the treatment of selenium, not specifically limiting its search to pulp and paper mills. Table 4-63 summarizes the identified treatment systems and their effectiveness. EPA did not identify any studies specifically citing the selenium removal for the pulp and paper industry. However, other industries, such as coal mining and petroleum refining, remove metals using biological treatment, chemical precipitation, membrane filtration, ion exchange, and adsorptive media. The reviewed studies showed reported selenium effluent concentrations ranging from less than 0.9 µg/L to 88 µg/L, and removal efficiencies ranging from 62.6 percent to 99.4 percent. The median concentrations from the trade association effluent data (ranging from 1.49 µg/L to 3.2 µg/L) are on the lower end of the effluent concentration range identified from IWTT. Therefore, the studies do not demonstrate the availability of technologies that can reduce selenium concentrations to below levels currently measured in pulp and paper mill discharges.

Table 4-63. Summary of Wastewater Treatment Technologies for Selenium

Parameter	Wastewater Treatment Technology (Order of Unit Processes)	Effluent Selenium Concentration (µg/L)[a]	Percent Removal	Industry	Treatment Scale	Reference
Selenium	Bag & Cartridge Filtration, Oil/Water Separation, Flow Equalization, Membrane Filtration	< 5	NR	Metal finishing	Pilot	(Pugh, et al., 2014)
	Mechanical Pre-Treatment, Flow Equalization, Membrane Filtration	NR	99.4%	Nonferrous metals manufacturing	Pilot	(Kim, et al., 2013)
	Biological Activated Carbon Filters	NR	80%		Pilot	(Diels, et al., 2003)
	Constructed Wetlands	NR	85%	Steam electric power generating	Pilot	(Morrison, et al., 2011)
	Chemical Precipitation, Clarification	NR	70%	Petroleum refining	Pilot	(Mauro, et al., 2013)
	Chemical Precipitation	7.9	95%	Petroleum refining	Pilot	(Pulliam, et al., 2010)
Selenium, total	Chemical Precipitation, Dissolved Air Flotation, Membrane Filtration, Reverse Osmosis	6.2	85.6%	Oil and gas extraction	Pilot	(Mah, et al., 2011)
	Ion Exchange	< 1	> 86.3%	Coal mining	Pilot	(Martins, et al., 2012)
	Zero-Valent Iron	NR	85%			
	Anaerobic Fixed Film Biological Treatment, Constructed Wetlands	< 0.9	> 93.4%		Full	(Coal Mac Inc., 2011)
	Anaerobic Fixed Film Biological Treatment, Membrane Filtration	11.6	72.2%		Pilot	(Munirathinam, et al., 2011)
	Anaerobic Fixed Film Biological Treatment, Granular-Media Filtration	< 4.7	> 88.8%		Pilot	(Webster, et al., 2012)
	Anaerobic Fixed Film Biological Treatment, Moving Bed Bioreactor	84	76.6%		Pilot	(Gay, et al., 2012)
	Chemical Precipitation, Ballasted Clarification	6.8	62.6%	Petroleum refining	Pilot	(McCloskey & Jettinghoff, 2009)
	Adsorptive Media	9	70%		Full	(Hayes & Sherwood, 2012)
	Chemical Precipitation, Clarification, Flow Equalization, Ion Exchange, Anaerobic Suspended Growth, Clarification	88	85.9%	Steam electric power generating	Full	(Andalib, et al., 2016)

[a] Some studies reported effluent concentration data in mg/L. EPA converted the data to µg/L to facilitate comparison with mill effluent selenium concentrations.
NR – Not Reported

Review of Total Reduced Sulfur Discharges

Because total reduced sulfur (TRS) is not a TRI-listed pollutant, no U.S. pulp and paper mills reported TRS releases in the 2013 TRI. In NPRI, TRS is calculated as the sum of the following compounds expressed as hydrogen sulfide: hydrogen sulfide, carbon disulfide, carbonyl sulfide, dimethyl sulfide, methyl mercaptan, and dimethyl disulfide (Environment Canada, 2015). Both U.S. and Canadian pulp and paper mills reported hydrogen sulfide separately from TRS. The 2013 List of TRI Chemicals includes carbon disulfide and carbonyl sulfide; however, the U.S. pulp and paper mills did not report either of these pollutants to TRI in 2013. Dimethyl sulfide, methyl mercaptan, and dimethyl disulfide are not in the 2013 List of TRI Chemicals. EPA reviewed 2013 DMR data and did not identify discharges of carbon disulfide, carbonyl sulfide, dimethyl sulfide, methyl mercaptan, and dimethyl disulfide discharges from pulp and paper mills.

Effective for the 2014 reporting year, NPRI no longer requires reporting of TRS releases to surface water (Environment Canada, 2015). Environment Canada states that TRS reporting had been included due to concerns about releases to air, not water. NPRI continues to require reporting of releases to water of hydrogen sulfide, carbon disulfide, and carbonyl sulfide individually (as does TRI). NPRI no longer requires reporting of water releases of dimethyl sulfide, methyl mercaptan, and dimethyl disulfide.

EPA considered the components of TRS individually to evaluate the need for further review. Based on the changes made to NPRI reporting requirements, dimethyl sulfide, methyl mercaptan, and dimethyl disulfide are not a priority for this review as they are likely air release concerns, not water release concerns. Pulp and paper mills reported hydrogen sulfide releases to both NPRI and TRI. EPA is already investigating releases of hydrogen sulfide, as discussed in Section 4.3.5. While carbon disulfide and carbonyl sulfide are included in the 2013 List of TRI Chemicals, no pulp and paper mills reported releasing these chemicals in 2013, either to TRI or on DMRs. Therefore, the data do not suggest that total reduced sulfur discharges from pulp and paper mills in the U.S. are a concern.

4.3.7 Summary of the Pulp & Paper Category Review

From its evaluation of lead, mercury, manganese, and hydrogen sulfide discharges, EPA learned:

- *Lead.* Lead does not have limitations under the Pulp and Paper ELGs; however, EPA identified 175 mills with reported releases to TRI in 2014. The review of direct discharge concentration data on 2014 DMRs and provided by mills showed the median concentrations for both the DMR and TRI data are an order of magnitude below the 2006 Form 2C median concentration and Method 200.7 ML. The review of indirect discharge concentration data provided by the mills showed that all average concentrations fall below the Method 200.7 ML. Though not directly applicable to pulp and paper mill wastewater, EPA's review of available treatment technology information in IWTT identified effluent concentrations of lead similar to the 2014 median effluent lead concentrations identified during this review and well below the Method 200.7 ML for lead. Consistent with information from the 2006 detailed study, these analyses suggest that lead is not generally present at a level that could be controlled by further treatment.

- *Mercury.* Mercury does not have limitations under the Pulp and Paper ELGs; however, EPA identified 86 mills with reported releases to TRI in 2014. The review of direct discharge concentration data on 2014 DMRs and provided by mills, showed that the median concentrations for both the DMR and TRI data are two orders of magnitude below the 2006 Form 2C median concentration and Method 245.1 ML. The review of indirect discharge concentration data provided by the mills showed that two of three average concentrations are below the Method 245.1 ML and the third average concentration is the same order of magnitude as the Method 245.1 ML. Though not directly applicable to pulp and paper mill wastewater, EPA's review of available treatment technology information in IWTT identified that effluent concentrations of mercury are similar to the 2014 median effluent mercury concentrations identified during this review. Consistent with information from the 2006 detailed study, these analyses suggest that mercury is not generally present at a level that could be controlled by further treatment. Further, as shown in Table 4-39, several of the mills that provided data for this review indicate that they have put in place measures to monitor and control their sources of mercury.
- *Manganese.* Manganese does not have limitations under Pulp and Paper ELGs; however, EPA identified 110 mills with reported releases to TRI in 2014. The median direct and indirect discharge concentrations, including the additional concentration data provided by the trade associations, are generally two orders of magnitude or more above the Method 200.7 ML, but similar to the 2006 Form 2C median concentration. These data are consistent with information from the 2006 detailed study and suggest that manganese discharges may be generally present at a level that could be controlled by further treatment.

  During the 2006 detailed study, EPA identified that manganese concentrations are frequently higher in mill intake than in mill effluent and that the cost of treatment technologies targeting manganese make such technologies infeasible. EPA's review of information provided by trade associations showed that wood furnish, and coal and oil used for energy generation may be primary sources of manganese in effluent discharges. Intake water may also be a source of manganese, though upstream monitoring data from EPA's WQX suggest intake concentrations are generally lower than the evaluated effluent concentrations. At least one mill that EPA contacted during the review (Georgia-Pacific Crossett) indicated that surface water is a large source of manganese.

  Trade associations suggest that treatment technologies currently implemented by the industry do not specifically target removal of manganese but may incidentally remove manganese. Though not directly applicable to pulp and paper mill wastewater, EPA's review of available treatment technology information in IWTT identified effluent concentrations of manganese similar to the 2014 median effluent manganese concentrations identified during this review. These data do not conclusively demonstrate that the available technologies can reliably reduce manganese concentrations to below levels currently measured in pulp and paper mill discharges.

- *Hydrogen sulfide*. Hydrogen sulfide was added as a TRI reporting requirement in 2012. Due to the number of mills with hydrogen sulfide releases in TRI, lack of historical release data, and possible overestimation of hydrogen sulfide releases in TRI data due to the current sampling convention, EPA further reviewed releases of hydrogen sulfide. EPA's discussions with pulp and paper trade associations indicate that sampling methods have not been updated. Additionally, pulp and paper mills identified errors in their 2014 hydrogen sulfide data reported to TRI and provided corrected data. These corrections decreased the hydrogen sulfide 2014 TRI TWPE from 1,230,000 to 580,000. These analyses suggest that the hydrogen sulfide releases reported to TRI are still likely to be overestimated. In response, the industry is working to refine the sampling methods that will improve the accuracy of hydrogen sulfide data reported to TRI in the future.

EPA's review of Canada's NPRI identified 15 pollutants that were reported to NPRI in 2013, but not to TRI. EPA focused its review on cadmium, selenium, total phosphorus, and total reduced sulfur, as these pollutants were reported by more than 20 percent of the pulp and paper mills that reported to NPRI in 2013.

- *Cadmium and selenium*. Large percentages of Canadian pulp and paper mills reported releases of cadmium and selenium in the 2013 NPRI data (72 percent and 33 percent, respectively). Cadmium and selenium are on the 2013 List of TRI Chemicals; however, no mills reported releases to TRI in 2013. EPA identified that the TRI reporting thresholds are higher than the NPRI reporting thresholds for these pollutants, and that the differences in reporting requirements may explain the difference in reporting rates. EPA also identified only three mills with cadmium discharges and two mills with selenium discharges reported on 2013 DMRs. Cadmium and selenium discharges reported on DMRs were generally lower than releases of these chemicals reported to NPRI.

  From review of additional information provided from pulp and paper trade associations, the median cadmium and selenium concentrations provided by trade associations are below the respective Method 200.7 ML (and ten times the ML), and therefore, may not be present at levels substantial enough for further treatment. EPA's review of information provided by trade associations suggests that wood chips may be primary sources of cadmium in effluent discharges and wood furnish, process additives such as phosphoric acid and sulfuric acid, and other raw materials used by the mills may all be possible sources of selenium in effluent discharges. Intake water may also be a source of cadmium, though upstream monitoring data from EPA's WQX suggest that intake concentrations are generally lower than the evaluated effluent concentrations. Review of upstream monitoring data from EPA's WQX did not yield any detectable concentrations of selenium, suggesting that intake water is not a source of selenium in pulp and paper mill effluent.

  Additionally, trade associations suggest that treatment technologies currently implemented by the industry do not specifically target removal of cadmium or selenium, but that biological treatment may incidentally remove cadmium or selenium. EPA queried the IWTT Database and did not identify information for technologies that achieve cadmium or selenium concentrations below levels currently measured in pulp and paper mill wastewater discharges; however, the data were not specific to pulp and paper mills.

- *Total phosphorus.* Seventy-eight percent of Canadian pulp and paper mills with NPRI data reported releases of total phosphorous in 2013 NPRI data. EPA's investigation identified that NPRI and TRI have different reporting requirements for the different types of phosphorus, and TRI does not require reporting of total phosphorus. EPA reviewed 2013 DMR data and identified that 45 percent of pulp and paper mills reporting any pollutant loadings reported total phosphorous loads greater than zero. EPA has not previously evaluated total phosphorous discharges from pulp and paper mills. In general, the magnitude of total phosphorus releases in the 2013 NPRI is similar to the 2013 DMR total phosphorus loadings. Additionally, trade associations confirmed that mills often add supplemental forms of phosphorus to nutrient deficient wastewaters to ensure effective biological treatment. Other sources of phosphorus in pulp and paper mill wastewaters include raw materials, intake water, and process additives. Pulp and paper mills may implement phosphorous residual minimization techniques, but few operate treatment systems for removing residual nutrients from biologically treated effluents.
- *Total reduced sulfur.* NPRI has revised its reporting requirements for TRS. Mills are no longer required to report TRS but are required to report water releases of some TRS components, including hydrogen sulfide, carbon disulfide, and carbonyl sulfide. EPA is already investigating hydrogen sulfide, as discussed in Section 4.3.5. EPA did not identify any pulp and paper mills with 2013 DMR carbon disulfide or carbonyl sulfide discharges.

4.3.8 Pulp & Paper Category References

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5. EPA's Review of Additional Industrial Categories

During the 2015 Annual Review, EPA also initiated a review of two additional point source categories to address comments received from stakeholders regarding recent changes to these industries as well as potential new pollutant releases to the environment through industrial wastewater discharge: Battery Manufacturing (40 CFR Part 461) and Electrical and Electronic Components (40 CFR Part 469) (EPA-HQ-OW-2015-0665-0299). From the 2015 Annual Review, data indicated that both industries have undergone technology advancements since the promulgation of the respective effluent limitations guidelines and standards (ELGs). However, EPA did not yet identify sufficient information to evaluate how the industry changes impact production processes, wastewater discharge and treatment, or applicability of the existing ELGs (EPA-HQ-OW-2015-0665-0290).

EPA continued its review of these two categories. Specifically, EPA conducted targeted literature reviews, attended industry conferences, met with trade associations, contacted facilities, reviewed company websites, evaluated available industry economic data, reviewed permit information, and analyzed readily available data on current discharges. EPA aimed to:

- Understand the current scope of the industries, including what types of products are currently, or are planned to be, manufactured, and how the profiles of the industries have changed since the promulgation of the ELGs.
- Identify which manufacturers discharge wastewater, whether they discharge directly or indirectly, what types of products they produce, which products generate a wastewater discharge, and what pollutants are discharged.
- Assess how permit writers and facilities are applying the ELGs to direct and indirect dischargers.
- Evaluate current wastewater treatment technologies and management techniques used by industry for identified processes and pollutants, and their ability to further reduce pollutant discharges.

In addition, EPA reviewed miscellaneous food and beverage manufacturing sectors not currently regulated by national ELGs, to identify specific sectors that may require further review for the potential development of ELGs.

EPA documented the quality of the data supporting its review of these industrial categories and sectors, analyzed how the data could be used to characterize the industrial wastewater discharges, and prioritized the evaluations for further review. See Appendix A of this report for more information on data usability and the quality of the data sources supporting these reviews.

Sections 5.1 and 5.2 of this report provide details of EPA's continued review of Battery Manufacturing and Electrical and Electronic Components, respectively. Section 5.3 of this report provides details of EPA's review of the miscellaneous food and beverage manufacturing sectors.

5.1 Battery Manufacturing (40 CFR Part 461)

As a part of its 2015 Annual Review, EPA initiated a preliminary review of the Battery Manufacturing Point Source Category Effluent Limitations Guidelines and Standards (ELGs) in response to stakeholder concerns about potential pollutants in wastewater discharges during the manufacture of new, advanced types of battery technologies, including development of rechargeable vanadium redox batteries and production of rechargeable lithium-ion batteries (including electric vehicle batteries). Unsolicited comments from stakeholders originally expressed these concerns, as well as comments submitted to EPA in response to the *Final 2010 Effluent Guidelines Program Plan* (76 FR 66286) (U.S. EPA, 2013).

During the 2015 Annual Review, EPA reviewed these ELGs, collected information about the current status of U.S. battery manufacturing, and evaluated the applicability of the existing ELGs to advances in battery technologies to learn whether recent changes within the industry have resulted in new wastewater pollutant discharges not currently covered by the existing ELGs. The existing rule applies to any battery manufacturing facility that discharges a pollutant to waters of the U.S or to publicly owned treatment works (POTWs); the discharge requirements vary depending on the anode materials (e.g., cadmium, lead, etc.). The preliminary review indicated that battery technologies have greatly advanced since 1984 with the advent of rechargeable batteries, such as lithium-ion and vanadium redox. Stakeholders questioned whether the existing ELGs are applicable to the manufacture of some of these types of batteries because their anode materials might not be covered by any of the specific ELG subcategories. Further, rechargeable batteries are generally identified by the ions (in the electrolyte) travelling between electrodes. The anode materials may vary within the same common battery type. For example, lithium-ion batteries with different anode composition may be covered under different subparts, or not at all (U.S. EPA, 2016).

The 2015 Annual Review identified only limited information regarding the extent of U.S. manufacturing of advanced and emerging battery technologies. EPA identified one facility, a Tesla Motors plant in Nevada, which will be manufacturing lithium-ion batteries on a large scale. In addition, stakeholders expressed concern over potential growth in manufacturing of vanadium redox and electric vehicle batteries and the implications of such growth for wastewater management. While battery technologies are advancing, EPA identified no generally available information regarding the generation of wastewater discharges from the manufacture of these new battery technologies (U.S. EPA, 2016).

As part of the current review, EPA evaluated 2014 discharge monitoring reports (DMRs) and the Toxics Release Inventory (TRI), National Pollutant Discharge Elimination System (NPDES) permits, and company websites. EPA's purpose was to:

- More thoroughly understand the current and emerging U.S. battery manufacturing industry, including the types of batteries produced, and applicability of the ELGs to those battery types.
- Identify new battery technologies, focusing on the design of the batteries and their industrial and commercial applications.
- Evaluate emerging battery technology processes and wastewater generated by them.

EPA also conducted a literature review to supplement the information gathered from the 2014 DMR and TRI data, NPDES permits, and company website searches. EPA documented the quality of the data supporting its review of this industry, analyzed how the data could be used to characterize the industrial wastewater discharges, and prioritized the results for further review. See Appendix A of this report for more information on data usability and the quality of data sources supporting this review. In addition, Appendix B of this report provides a list of the keywords that EPA used for the literature review searches.

The following sections provide an overview of the Battery Manufacturing ELGs, an overview of the industry profile, and a review of battery manufacturing wastewater generation and discharge.

5.1.1 Overview of Existing Battery Manufacturing ELGs

The Battery Manufacturing ELGs (40 CFR Part 461) were promulgated in 1984. The rule defines "battery" as a modular electric power source where part or all of the fuel is contained within the unit and electric power is generated directly from a chemical reaction rather than indirectly through a heat cycle engine. A battery cell has three major components: anode, cathode, and electrolyte. In addition, there are mechanical and conducting parts, such as a case, separator, or contacts. Production of batteries includes the electrode manufacture of anodes and cathodes and associated ancillary operations to produce the battery (U.S. EPA, 1984a). The ELGs set limits for subcategories based on the anode material: cadmium, calcium, lead, lithium, magnesium, and zinc; with an additional subcategory for leclanché cells (zinc anode batteries with acid electrolyte). Table 5-1 presents the applicability of each subcategory in the Battery Manufacturing ELGs and the regulated pollutants. Limitations are production normalized by the weight of the anode material, cathode material, or the entire battery cell, depending on the subcategory and waste stream.

Table 5-1. Applicability and Regulated Pollutants for the Battery Manufacturing Category

Subpart	Subcategory	Applicability	Cadmium	Chemical Oxygen Demand (COD)	Chromium	Cobalt	Copper	Cyanide	Iron	Lead	Manganese	Mercury	Nickel	Oil and Grease	pH	Silver	TSS	Zinc
A	Cadmium	Manufacture of cadmium anode batteries.	✓			✓							✓	✓	✓	✓	✓	✓
B	Calcium	Manufacture of calcium anode batteries.	Zero Discharge															
C	Lead	Manufacture of lead anode batteries.					✓		✓	✓				✓	✓		✓	
D	Leclanché	Manufacture of Leclanché type batteries (zinc anode batteries with acid electrolyte).									✓	✓		✓	✓		✓	✓
E	Lithium	Manufacture of lithium anode batteries.			✓				✓	✓					✓		✓	
F	Magnesium	Manufacture of magnesium anode batteries.		✓					✓	✓					✓	✓	✓	
G	Zinc	Manufacture of zinc anode batteries.			✓			✓			✓	✓	✓	✓	✓	✓	✓	✓

Source: 40 CFR Part 461

5.1.2 Battery Manufacturing Industry Profile

During the 2015 Annual Review, EPA learned that battery technologies have substantially changed since the promulgation of the Battery Manufacturing ELGs in 1984. To explicate these changes, EPA prepared a summary of the 1984 industry profile, a current profile of battery manufacturing industry, and a discussion of new battery technologies that represent the potential future of the battery manufacturing industry.

5.1.2.1 1984 Industry Profile

As explained above, EPA subcategorized this industry category on the basis of anode material and electrolyte. At the time of the rulemaking, data showed that battery cells with common process operations frequently used the same anode material, and that facilities manufacturing batteries with a common anode material generated wastewater bearing the same major pollutants (U.S. EPA, 1984a).

Typical applications of the batteries studied as part of the rulemaking ranged from use in small electronics (e.g., flashlights, calculators) to automotive and special military operations. Research performed during the rulemaking led EPA to decide that the value of industry products was increasing significantly at the time, accompanied by shifts in battery applications, the emergence of new types of cells, and the phase-out of other battery types. In 1984, EPA predicted that research in batteries and the continuing changes in electronics and transportation would continue to lead to rapid changes in battery manufacturing. The 1984 profile showed that over half of the manufacturing plants in the U.S. were less than 20 years old. Some manufacturing plants purchased finished cell components and assembled final battery products, some only manufactured battery components, and some had fully integrated onsite production operations, including metal forming and inorganic chemicals manufacture (U.S. EPA, 1984a).

As part of the rulemaking, EPA collected information from 254 U.S. battery manufacturing facilities. At the time, 21 facilities reported having direct discharges to surface waters, 149 reported discharges to POTWs, and 84 reported zero discharges. Lead battery manufacturing facilities accounted for greater than 70 percent of all facilities and about 90 percent of process wastewater flow. Cadmium, leclanché, and zinc battery manufacturers together made up 20 percent of all facilities and 10 percent of process wastewater flow (U.S. EPA, 1984a, 1984b).

The 1984 industry profile showed that water was used throughout the battery manufacturing process to clean battery components and to transport wastes. Water was used in the chemical systems to make most electrodes and special electrode chemicals and was a major component of most electrolyte and formation baths. Based on sampling done for the 1984 rulemaking, EPA learned that the pollutants in battery manufacturing wastewater varied depending on the anode and included (U.S. EPA, 1984a):

- Toxic metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc).[35]

[35] Arsenic and selenium are not regulated parameters under 40 CFR Part 461; however, arsenic and selenium were cited as verification parameters in the 1984 rulemaking for the leclanché and zinc subcategories (U.S. EPA, 1984a).

- Nonconventional pollutants (aluminum, cyanide, cobalt, iron, manganese, and chemical oxygen demand (COD)).[36]
- Conventional pollutants (oil and grease, total suspended solids (TSS), and pH).

The control and treatment technologies available for the battery industry at the time of the 1984 rulemaking included both in-process and end-of-pipe operations. The technology basis for the limitations and standards included a variety of water flow reduction steps and process changes (e.g., substitution of non-wastewater-generating forming systems). End-of-pipe treatment included hexavalent chromium reduction, chemical precipitation, settling/sedimentation, and filtration (U.S. EPA, 1984a).

5.1.2.2 Current Industry Profile

For the current review, EPA reviewed publicly available U.S. Economic Census data, 2014 DMRs, and the 2014 TRI to evaluate the current number of battery manufacturers in the U.S. and understand the nature of their industrial wastewater discharges. EPA first reviewed the North American Industry Classification System-Point Source Category (NAICS-PSC) and Standard Industrial Classification-Point Source Category (SIC-PSC) crosswalks developed for the 304m Annual Review process.[37] From this review, EPA identified two NAICS codes that correspond to facilities that are likely to fall under the Battery Manufacturing Category:[38]

- 335911 – Storage Battery Manufacturing
- 335912 – Primary Battery Manufacturing

A storage battery is a battery that can store chemical energy with the potential to change to electricity. The conversion of chemical energy to electricity can be reversed, thus allowing the battery to be recharged. Examples of storage batteries include automobile batteries, lead-acid batteries, and alkaline cell batteries (nickel-cadmium, nickel-iron, silver oxide-zinc). Primary batteries, in contrast, cannot usually be recharged and must be replaced after one discharge (U.S. EPA, 1984a). Examples of primary batteries include disposable flashlight batteries and watch batteries. Based on the 2012 U.S. Economic Census data, EPA identified 140 U.S. battery-manufacturing establishments,[39] the majority of which are in California, Missouri, Florida, Illinois, Massachusetts, and Michigan (ERG, 2016a). To identify potential trends in the industry, EPA compared the number of establishments reported in every U.S. Economic Census year from 1977 to 2012. Figure 5-1 presents the results of EPA's comparison. The number of battery

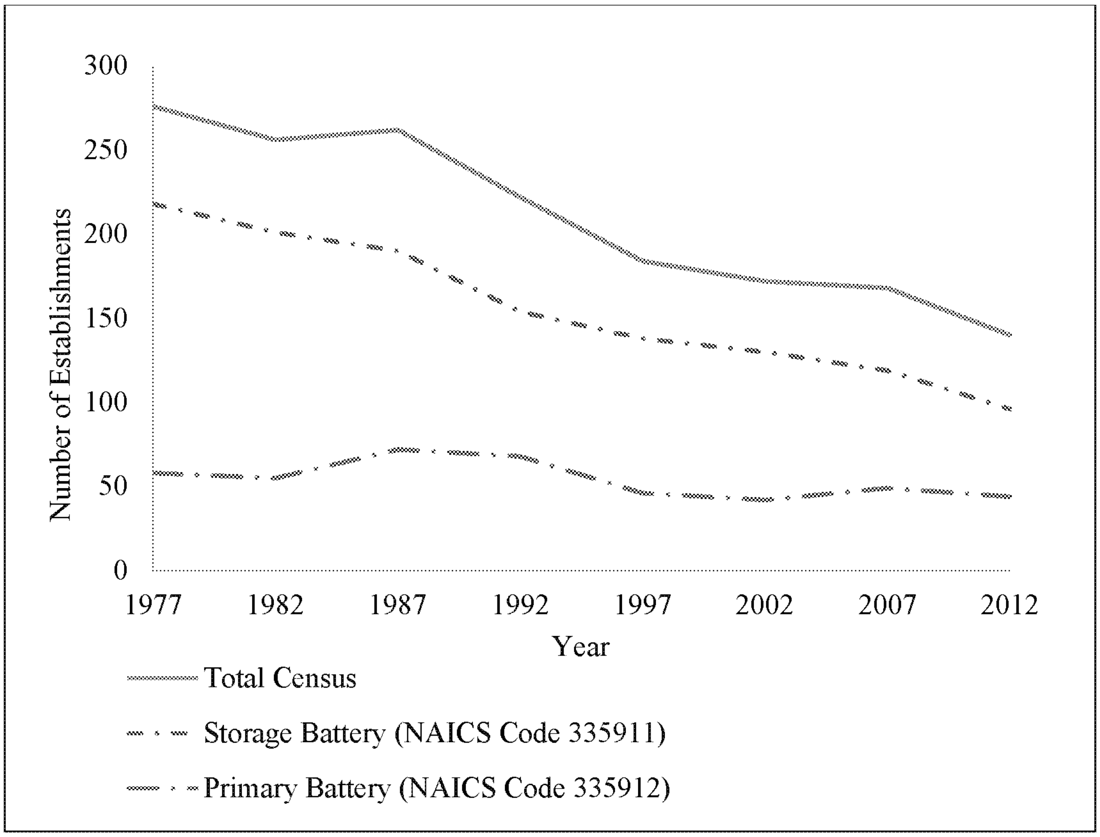
[36] Aluminum is a not a regulated parameter under 40 CFR part 461; however, was cited as a verification parameter in the 1984 rulemaking for the zinc subcategory (U.S. EPA, 1984a).

[37] For further information on the NAICS-PSC and SIC-PSC crosswalks, see the *Technical Support Document for the Annual Review of Existing Effluent Guidelines and Identification of Potential New Point Source Categories* (U.S. EPA, 2009).

[38] The corresponding SIC codes are: 3691 (Storage Batteries) and 3692 (Primary Batteries, Wet and Dry).

[39] Defined as a business or industrial unit at a single location that distributes goods or performs services. It is not necessarily identified with a company or enterprise, which may consist of one or more establishments. When two or more activities are carried on at a single location under a single ownership, all activities generally are grouped together as a single establishment. The entire establishment is classified on the basis of its major activity and all data are included in that classification (U.S. Census Bureau, 2016).

manufacturing establishments for both NAICS codes, and the total battery manufacturing industry, declined from 1977 to 2012.



Source: (ERG, 2016a)

Figure 5-1. Number of U.S. Battery Establishments from 1977 through 2012

EPA also reviewed the total number of battery manufacturing facilities reporting 2014 DMR and TRI discharges greater than zero. As shown in Table 5-2, EPA identified 56 battery manufacturers reporting 2014 discharges, the majority of which are indirect dischargers. This is approximately one-third of the total number of battery manufacturing facilities identified as part of the 1984 rulemaking (21 direct dischargers and 149 indirect dischargers). While the DMR and TRI datasets provide the most comprehensive source of information on existing wastewater discharges in the U.S., this count may not represent the total number of battery manufacturer discharges in 2014, see Section 2.1 of this report for details on the utility and limitations of the DMR and TRI data.

EPA notes that the U.S. Economic Census data include more facilities than the 2014 DMR and TRI data. There are several potential reasons for this: some facilities may not meet TRI-reporting thresholds; some facilities may be classified as minor dischargers and therefore, may not be captured in the DMR data;[40] some facilities in the U.S. Economic Census data are

[40] Minor dischargers must report compliance with NPDES permit requirements via monthly DMRs submitted to the permitting authority; however, EPA does not require the permitting authority to enter the data in the Integrated Compliance Information System for the National Pollutant Discharge Elimination System (ICIS-NPDES) which contains the DMR data.

distributors or sales facilities, not manufacturers; and some battery manufacturers may not discharge wastewater and, therefore, may not report to DMR and/or TRI.

Table 5-2. Number of Battery Manufacturing Facilities in the DMR and TRI Data

Year of Discharge	Year of Review	2014 DMR Facilities[a]	2014 TRI Facilities		
			Direct Only	Indirect Only	Both Direct and Indirect
2014	2016	2	1	36	19

Sources: *DMRLTOutput2014_v1 and TRILTOutput2014_v1.*
Note: Number of facilities with loadings greater than zero.
[a] Both 2014 DMR facilities are classified as minor dischargers.

For all 56 battery manufacturers reporting 2014 DMR and TRI discharges greater than zero, EPA reviewed company websites to identify the types of batteries currently being manufactured in the U.S. (ERG, 2016b).[41] Table 5-3 summarizes the battery types and the number of facilities manufacturing each type. As shown by the facility counts, several facilities manufacture more than one type of battery. From its review of the battery types, EPA also attempted to assign the applicable subcategory from the Battery Manufacturing ELGs.

Table 5-3. Types of Batteries Manufactured in the U.S. Associated with 2014 Wastewater Discharges

Battery Type	Count of Facilities	Applicable Subcategory(ies)
Alkaline	4	Zinc
Carbon-Zinc	1	Leclanché
Lead Carbon	1	May be Subject to Lead Subcategory
Lead-Acid	40	Lead
Lithium-ion	14	May be Subject to Lithium Subcategory
Nickel-cadmium	4	Cadmium
Nickel-hydrogen	1	May be Subject to Cadmium Category
Zinc Air	2	Leclanché, Zinc

Source: (ERG, 2016b).

This review indicates that the majority of battery manufacturers in the U.S. currently manufacture lead-acid and lithium-ion batteries.

[41] Both facilities reporting 2014 DMR discharges are also captured in the 2014 TRI counts; therefore, the total number of facilities is 56, not 58.

5.1.2.3 Potential Future Industry Trends

Though EPA's review of the U.S. Census data indicates an overall decline in the number of battery manufacturing facilities in the U.S since the 1984 rulemaking, information gathered during the 2015 Annual Review indicates the potential emergence of new battery technologies into the market. To further EPA's understanding of future industry trends and in light of recent technology advances within the industry, EPA conducted a literature review, reviewed economic forecasts, and contacted battery manufacturers as part of this review. EPA's literature review focused on identifying emerging battery technologies and the manufacturers of these new batteries in the U.S. See Appendix B for the keyword searches done for the literature review.

From the literature review, EPA identified several lithium-ion battery manufacturers associated with the electric vehicle industry that are currently operating or planning to operate in the U.S. The literature suggests that the majority of these manufacturers are not operating at full capacity, as the electric vehicle industry is still developing (Bomgardner, 2012).

Economic forecasting data confirm that the battery manufacturing industry has declined over the past five years. The declining demand for battery manufacturing in the U.S. results largely from the introduction and use of rechargeable batteries in smart phones, tablets, and other electronics. The demand for batteries in the U.S. is further limited by the fact that the majority of these electronics are manufactured overseas in countries that produce and use their own respective batteries. However, the economic forecasting data also show that the battery manufacturing industry will grow slightly over the next five years, due to the demand for rechargeable batteries to power electric vehicles manufactured in the U.S. (IBISWorld, 2016).

5.1.2.4 Emerging Battery Technologies Review

EPA's literature review and search of company websites also identified several new battery technologies since the 1984 ELGs. In addition to rechargeable lithium-ion batteries, rechargeable nickel-hydrogen, nickel-metal hydride, and vanadium-redox flow batteries have been developed. Based on the initial review, EPA further investigated the battery components, current applications, and any information on the manufacture of these batteries in the U.S. The following subsections present information on these emerging battery technologies.

Lithium-ion Batteries

Lithium-ion batteries are rechargeable batteries in which lithium-ions move from the anode to the cathode during discharge and from the cathode to the anode during recharge. Lithium-ion battery technologies are rapidly advancing, and there are many battery types and configurations using a variety of materials for the anode, cathode, and electrolyte. In these batteries, lithium is not necessarily the anode material, but often part of the electrolyte, which can be a solid or liquid medium (Salkind, et al., 2003). Graphite or hard carbon is often used as the anode material, as well as lithium and lithium alloys. The industry is also developing lithium-ion batteries using silicon as the anode material (Patterson, 2009).

As shown in Table 5-3, EPA identified 14 facilities manufacturing lithium-ion batteries in the U.S. reporting wastewater discharges. Currently, the ELGs cover wastewater discharges from the manufacture of lithium-ion batteries that use lithium as the anode material (Subpart E, Lithium). This subpart does not cover manufacture of lithium-ion batteries using non-lithium anode materials.

Lithium-ion batteries are used in a variety of applications, including advanced start/stop vehicles, hybrid and electronic vehicles, aircraft, and other specialty applications (ERG, 2016b). In addition to the 14 facilities reporting discharges from lithium-ion battery manufacturing in 2014, EPA identified another U.S. facility, as part of the 2015 Annual Review, that began manufacturing lithium-ion (i.e., rechargeable) batteries in the U.S., the Tesla Motors Gigafactory in Nevada. EPA contacted Tesla for information about the Gigafactory, which began battery cell production on January 4, 2017, and is scheduled to reach full manufacturing capacity by 2018 (Tesla Motors, 2017). The Gigafactory will manufacture lithium-ion batteries for use in electronic vehicles and the Powerwall, a rechargeable lithium-ion battery designed to store energy at individual residences, to be used for load shifting, backup power, and self-consumption of solar power generation. Tesla indicated that the facility will not discharge any wastewater and that they anticipate that by 2020 this factory will produce more lithium-ion batteries annually than were produced worldwide in 2013 for electric vehicles and rechargeable homes (Jackson, 2016; Tesla Motors, 2015, 2017).

Nickel-Hydrogen Batteries

Nickel-hydrogen batteries are rechargeable batteries with a solid nickel electrode and a negative platinum gas electrode. The negative platinum gas electrode contains catalyzed sites that allow for the electrochemical reaction of hydrogen gas. The cell case for this type of battery is a pressure vessel as the negative active material is hydrogen gas. Nickel-hydrogen batteries began replacing nickel-cadmium batteries after successful use on communication satellites in 1983. Because these batteries are primarily used in aerospace energy storage applications, NASA is the biggest researcher and producer (Thaller & Zimmerman, 2003).

As shown in Table 5-3, EPA identified one U.S. facility (Duracell, in LaGrange, GA) that may be manufacturing nickel-hydrogen batteries and reporting wastewater discharges in 2014. The facility reported releases totaling less than 1 pound of pollutants to a POTW. Based on EPA's review of nickel-hydrogen battery production and the Battery Manufacturing ELGs, wastewater discharges from the manufacture of nickel-hydrogen batteries are currently not subject to the ELGs.

Nickel-Metal Hydride Batteries

Nickel-metal hydride batteries are rechargeable batteries with a nickel hydroxide cathode, misch metal hydride anode, a potassium hydroxide electrolyte, and a porous polypropylene membrane separator. These batteries have become popular and are replacing nickel-cadmium batteries in many applications, specifically in the hand-held power tools market, and are also used in hybrid electric vehicles. However, one source (Argonne National Laboratory (ANL), 2010) indicated that lithium-ion batteries are starting to replace nickel-metal hydride batteries, owing to superior specific energy and cycle life.

Ovonic Battery Corporation (currently known as BASF Corporation) invented nickel-metal hydride batteries. It is not known whether the BASF Corporation manufacturing facilities in the U.S. are currently manufacturing nickel-metal hydride batteries (BASF, 2016). As shown in Table 5-3, EPA did not identify any U.S. battery manufacturing facilities reporting 2014 DMR or TRI discharges associated with the manufacture of nickel-metal hydride batteries. Based on EPA's review of nickel-metal hydride battery production and the Battery Manufacturing ELGs, wastewater discharges from the manufacture of nickel-metal hydride batteries are currently not subject to the ELGs.

Vanadium Redox Flow Batteries

EPA's research indicates that vanadium redox, or vanadium flow, batteries are being developed to function as sources of energy during power outages and for use in remote areas and developing countries. These batteries are rechargeable and generate electricity by pumping liquid electrolytes containing vanadium ions through electrochemical cells separated by ion selective membranes (Salkind, et al., 2003). Unlike traditional batteries, flow batteries are not closed systems. This allows for potential replacement of depleted electrolyte and may result in a reduced rate of degradation of the anode and cathode materials (St. John, 2014). Flow batteries contain a liquid electrolyte; therefore, handling may be a concern for disposal or waste management.

Available information suggests that vanadium redox battery manufacturing in the U.S. is currently limited to the research and development phase. Graphite, which is not an anode material subject to the current ELGs, is a commonly used anode material in vanadium flow batteries (U.S. EPA, 2016).

5.1.2.5 Evaluation of Current Wastewater Discharges

In order to further review the battery manufacturing industry and understand current wastewater discharges, EPA evaluated the 2014 DMR and TRI data for the 56 facilities reporting discharges. Table 5-4 and Table 5-5 provide a summary of the pollutant discharges across the facilities for the 2014 DMR and TRI data, respectively. The pollutants are ordered based on toxic-weighted pound equivalents (TWPE) discharged, calculated by assigning a relative toxic weighting factor to the estimated loads from each facility.[42]

Table 5-4. Battery Manufacturing Category: Pollutants Reported on 2014 DMRs

Pollutant	Number of Facilities Reporting Pollutant	Pollutant Load (lb/yr)	TWPE
Lead	2	56.5	126
Copper	1	0.830	0.517
Iron	1	8.06	0.0452
Chemical Oxygen Demand (COD)	1	9,190	0
Total Suspended Solids (TSS)	2	7,350	0
Oil and Grease	1	3,600	0
Battery Manufacturing Total	**2**	**20,200**	**127**

Source: *DMRLTOutput2014_v1*
Note: Sums of individual values may not equal the total presented, due to rounding.

[42] See Section 2 of EPA's *2015 Annual Review Report* for more information on how EPA applies toxic weighting factors to facility discharges in the DMR and TRI data (U.S. EPA, 2016).

Table 5-5. Battery Manufacturing Category: 2014 Pollutants Reported to TRI

Chemical Name	Number of Facilities Reporting Pollutant	Direct Discharge Pollutant Load (lb/yr)	Direct Discharge TWPE	Indirect Discharge Pollutant Load (lb/yr)	Indirect Discharge TWPE	Total Pollutant Load (lb/yr)	Total Pollutant TWPE
Lead and Lead Compounds	45	353	791	64.2	144	417	935
Sodium Dimethyldithiocarbamate	1	0	0	1,680	134	1,680	134
Cadmium and Cadmium Compounds	3	1.20	27.4	0.111	2.54	1.31	29.9
Nitrate Compounds	1	0	0	33,600	25.1	33,600	25.1
Manganese and Manganese Compounds	5	120	12.4	15.6	1.61	136	14.0
Copper and Copper Compounds	4	7	4.36	0.387	0.241	7.39	4.60
Nickel and Nickel Compounds	6	17.1	1.71	27.4	2.74	44.5	4.45
Zinc and Zinc Compounds	5	37	1.48	11.8	0.470	48.8	1.95
Cobalt and Cobalt Compounds	2	0	0	1.53	0.168	1.53	0.168
Antimony and Antimony Compounds	8	4.65	0.0465	1.09	0.0109	5.74	0.0574
Arsenic and Arsenic Compounds	2	0	0	0.0117	0.0404	0.0117	0.0404
Mercury and Mercury Compounds	2	0	0	0.000204	0.0224	0.000204	0.0224
Silver and Silver Compounds	1	0	0	0.00036	0.00593	0.00036	0.00593
Barium and Barium Compounds	1	2.74	0.00545	0	0	2.74	0.00545
Lithium Carbonate	1	0	0	0.99	0	0.99	0
N-Methyl-2-Pyrrolidone (NMP)	1	0	0	1,220	0	1,220	0
Total	**56**	**543**	**838**	**36,700**	**311**	**37,200**	**1,150**

Source: *TRILTOutput2014_v1.*
Note: Sums of individual values may not equal the total presented, due to rounding.

EPA compared the pollutants listed in Table 5-4 and Table 5-5 to the pollutants currently regulated by the ELGs (shown in Table 5-1). EPA learned that five of the six pollutants reported by the two DMR facilities are subject to limitations in the current ELGs for the lead subcategory as both facilities manufacture lead-acid batteries (the lead subcategory does not regulate COD). Out of the 16 pollutants reported in the 2014 TRI, seven are not currently subject to limitations in the ELGs, however, EPA recognizes that the seven pollutants may be controlled by the technology basis for the regulated pollutants in the applicable subcategory. These seven pollutants are:

- Sodium dimethyldithiocarbamate
- Nitrate compounds
- Antimony and antimony compounds
- Arsenic and arsenic compounds
- Barium and barium compounds
- Lithium carbonate
- N-Methyl-2-Pyrrolidone (NMP)

During the 1984 rulemaking, EPA reviewed antimony and arsenic discharges and did not identify them as pollutants of concern. As shown in Table 5-5 above, collective 2014 reported discharges of the two pollutants for this industry are about six pounds annually. The remaining five pollutants are not reported by more than one facility. Further, only the barium and barium compound releases are based on actual monitoring data; the rest of the TRI releases are estimated from calculations such as published emission factors, mass balance calculations, or other engineering calculations that can be used to estimate TRI releases.

Additionally, EPA attempted to find and review permit documentation for all 56 facilities reporting 2014 DMR discharges or 2014 TRI direct discharges. EPA was able to locate and review a total of seven NPDES permits to identify wastewater discharges associated with battery manufacturing processes.

As shown in Table 5-4, EPA identified only two facilities reporting discharges greater than zero in 2014 DMRs. Based on website searches described above, EPA learned that these two facilities manufacture lead-acid batteries (ERG, 2016b). One facility, Exide Technologies in Manchester, Iowa, has permit limits for process wastewater resulting from the production of lead-acid batteries for copper, lead, iron, oil and grease, and total suspended solids. These permit limits are based on water quality criteria and the current ELGs. The treatment at the facility includes chemical precipitation and clarification (IA DNR, 2014). The other facility, C&D Technologies in Attica, Indiana, is only authorized to discharge stormwater, not process wastewater from the manufacture of lead-acid batteries (IDEM, 2014).

EPA was able to obtain and review five additional NPDES permits for battery manufacturers identified as direct dischargers in the 2014 TRI.[43] Based on the company website and NPDES permit review, EPA learned that four of these facilities manufacture lead-acid

[43] Although these five facilities reported direct releases to the 2014 TRI, they may not be captured in the 2014 DMR data if they are minor dischargers, as some states do not upload DMRs for minor facilities.

batteries and are only authorized to discharge stormwater. The remaining permit limits discharges of non-contact cooling water and cooling tower blowdown from a facility that manufactures both lead-acid and lithium-ion batteries (ERG, 2016b).

To supplement discharge information obtained from its review of 2014 DMR, TRI, and NPDES permits, EPA also conducted a literature review of the production processes and wastewater generation from some of the emerging U.S. battery technologies. EPA focused this review on lithium-ion batteries because of the potential applicability considerations and the number of facilities reporting wastewater discharges associated with lithium-ion battery manufacturing in 2014 (see Table 5-3). EPA did not include a review of lead-acid batteries because they are subject to the current ELGs. EPA also did not include nickel-cadmium batteries because they are being phased out of production (i.e., replaced with nickel-metal hydride and other technologies), or nickel-metal hydride and vanadium redox batteries because they were not identified as being manufactured in the U.S on a large scale.

The basic production steps for lithium-ion batteries include the following (Argonne National Laboratory (ANL), 2010):

- Preparation of the cathode pastes and cathodes from purchased lithium metal oxides, binders, aluminum strips, and solvent.
- Preparation of anodes from graphics pastes and copper strips.
- Assembly of anodes and cathodes, separated by a separator strip.
- Addition of the electrolyte.
- Charging of the cells.
- Final assembly.

The literature review revealed that electrolyte processing, paste production, separator production, and formation/testing (i.e., final assembly) may generate wastewater during the manufacture of lithium-ion batteries. However, manufacturers may use either dry or wet processes for these production steps. Research suggests the industry is trending toward dry processes. For example, the industry developed dry electrode manufacturing, a process that eliminates the need for solvents in electrode processing and paste production steps, in 2016. While this process is still being researched, it may become the new industry standard given the environmental concerns surrounding NMP, a non-aqueous solvent traditionally used for electrode processing and paste production in lithium-ion battery production (Ludwig, et al., 2016).

EPA also attended a conference and spoke with several battery manufacturers to gather additional information on processes and wastewater discharges from battery manufacturing. EPA confirmed that there is little water used and/or generated in battery manufacturing processes (e.g., water for charging baths, cooling systems, electrolyte solutions, washing/cleaning processes) (ERG, 2016c). This information is consistent with information obtained from Tesla, which will be operating the Gigafactory in Nevada as a zero discharge facility (Jackson, 2016).

5.1.2.6 Summary of Evaluations from EPA's Review of Battery Manufacturing

EPA's research indicates that some battery technologies have changed since the promulgation of the Battery Manufacturing ELGs in 1984, with the advent of rechargeable batteries, including lithium-ion, nickel-hydrogen, nickel-metal hydride, and vanadium redox batteries. The ELGs apply to discharges from the manufacturer of batteries with specific anode materials (e.g., cadmium, lead, zinc). Some of the new battery technologies (i.e., lithium-ion) may not be covered under any of these specific ELG subcategories due to the variety of materials that can now be used for anodes. In addition, it is not clear that the existing ELGs cover or are applicable to several new battery technologies (e.g., lead carbon and nickel-hydrogen).

In its review of the battery manufacturing industry, EPA did not identify any uncontrolled pollutants that represent a category-wide issue. Further, the manufacture of emerging battery technologies in the U.S. is trending toward zero discharge and EPA identified few discharges that are not subject to the current ELGs. This is most notably demonstrated by the Tesla Gigafactory, which is expected to be the world's largest producer of lithium-ion batteries and will operate as a zero discharge facility (Jackson, 2016).

5.1.3 References for Battery Manufacturing (40 CFR Part 461)

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5.2 Electrical and Electronic Components (E&EC) (40 CFR Part 469)

As part of the 2015 Annual Review, EPA initiated a preliminary review of the Electronics and Electrical Components (E&EC) Category in response to stakeholder comments received during a 2014 National Association of Clean Water Agencies (NACWA) conference regarding the applicability of the effluent limitations guidelines and standards (ELGs) to the manufacture of sapphire crystals. Stakeholders expressed concerns about potential new pollutants of concern in the wastewater discharges from the manufacture of sapphire crystals (now commonly used in electronic devices), which they believe EPA did not consider during the development of the E&EC ELGs.

While the E&EC ELGs do not specifically mention sapphire crystals, from the 2015 Annual Review EPA identified that Subpart B - Electronic Crystals covers wastewater discharges generated from growing sapphire crystals and producing sapphire crystal wafers. Sapphire crystals are a crystal or crystalline material used in the manufacture of electronic devices because of their unique structural and electronic properties, and therefore, meet the applicability of Subpart B. Additionally, sapphire-crystal wafer production likely generates wastewater in the form of slurries and acids and confirmed that nanodiamonds are used in sapphire crystal polishing slurries. In addition, EPA identified several facilities in the U.S. that are currently manufacturing sapphire crystals and wafers. Following these preliminary results, EPA concluded that further review of the E&EC ELGs was appropriate.

EPA promulgated the E&EC ELGs (40 CFR Part 469) in 1983. Given the age of the ELGs and the changes that have occurred in the industry since their promulgation, EPA expanded the current review to include the entire E&EC Category, not just sapphire crystal manufacturing. The 1983 ELGs set limitations for four subcategories: semiconductors, electronic crystals, cathode ray tubes (CRTs), and luminescent materials. EPA further evaluated each of the four subcategories to:

- Understand the current U.S. E&EC industry and the extent to which it has changed since the promulgation of the ELGs.
- Identify which E&EC manufacturers discharge wastewater, whether they discharge directly or indirectly, what pollutants are discharged, and what electronics and electrical components they manufacture.
- Further understand and identify changes to the manufacturing steps associated with new E&EC operations since the 1983 rulemaking that may impact wastewater characteristics or management.
- Evaluate advancements in wastewater treatment technologies employed by facilities in the E&EC industry.
- Evaluate how the E&EC ELGs are applied in active National Pollutant Discharge Elimination System (NPDES) permits.

Section 5.2.1 provides details on the E&EC ELGs. Section 5.2.2 describes the industry profile, including facility types, process operations, and wastewater discharge practices in 1983 and the present. Section 5.2.3 provides information on E&EC wastewater characteristics in 1983 and the present. Section 5.2.4 presents a summary of the treatment technology basis for the E&EC ELGs and EPA's review of existing wastewater treatment technologies. Section 5.2.5 provides a summary of EPA's review of the E&EC Category.

5.2.1 Overview of Existing E&EC Effluent Limitations Guidelines and Standards (ELGs)

EPA promulgated the existing E&EC ELGs (40 CFR Part 469) in 1983, which established the Best Practicable Control Technology (BPT), Best Available Technology Economically Achievable (BAT), Best Conventional Pollutant Control Technology (BCT), Pretreatment Standards for Existing Sources (PSES), New Source Performance Standards (NSPS), and Pretreatment Standards for New Sources (PSNS) for the E&EC industry. EPA divided the E&EC Industry into four subcategories based on manufacture of the following products: semiconductors, electronic crystals, CRTs, and luminescent materials. EPA promulgated the E&EC ELGs in two phases: Phase I, published in April 1983, contains the ELGs for Subparts A (semiconductors) and B (electronic crystals) (U.S. EPA, 1983a); and Phase II, published in December 1983, contains the ELGs for Subparts C (CRTs) and D (luminescent materials) (U.S. EPA, 1983b). Table 5-6 provides a summary of the regulated pollutants by subcategory for the 1983 E&EC ELGs.

Table 5-6. Regulated Pollutants for the E&EC Category

Subpart	Subcategory	Total Toxic Organics[a]	Antimony	Arsenic	Cadmium	Chromium	Fluoride	Lead	pH	TSS	Zinc
BPT (Best Practicable Control Technology)											
A	Semiconductors	✓							✓		
B	Electronic Crystals	✓		✓			✓		✓	✓	
BAT (Best Available Technology Economically Achievable)											
A	Semiconductors	✓					✓				
B	Electronic Crystals	✓		✓			✓				
BCT (Best Conventional Pollutant Control Technology)											
A	Semiconductors								✓		
B	Electronic Crystals								✓	✓	
PSES (Pretreatment Standards for Existing Sources)											
A	Semiconductors	✓									
B	Electronic Crystals	✓		✓							
C	Cathode Ray Tubes	✓			✓	✓	✓	✓			✓
NSPS (New Source Performance Standards)											
A	Semiconductors	✓					✓		✓		
B	Electronic Crystals	✓		✓			✓		✓	✓	
C	Cathode Ray Tubes	✓			✓	✓	✓	✓	✓	✓	✓
D	Luminescent Materials		✓		✓		✓		✓	✓	✓

Table 5-6. Regulated Pollutants for the E&EC Category

Subpart	Subcategory	Total Toxic Organics[a]	Antimony	Arsenic	Cadmium	Chromium	Fluoride	Lead	pH	TSS	Zinc
PSNS (Pretreatment Standards for New Sources)											
A	Semiconductors	✓									
B	Electronic Crystals	✓		✓							
C	Cathode Ray Tubes	✓			✓	✓	✓	✓			✓
D	Luminescent Materials		✓		✓		✓				✓

Source: (U.S. EPA, 1983a, 1983b)
TSS – Total Suspended Solids
[a] Total toxic organics (TTO) indicates the sum of the concentrations for each of the toxic organic compounds which are in the wastewater discharge at a concentration greater than 10 μg/L. Table 5-7 and Table 5-8 provide the list of regulated toxic organic compounds for Subparts A, B, and C.

EPA established the E&EC ELGs specific to each subcategory based on their different raw materials, final products, manufacturing processes, geographical location, plant-size and age, wastewater characteristics, non-water quality environmental impacts, treatment costs, energy costs, and solid waste generation (U.S. EPA, 1983a, 1983b). The following subsections describe the two phases of the E&EC ELG development in more detail, the wastewater treatment technology bases for the ELGs, and other point source categories related to E&EC.

5.2.1.1 Phase I: Semiconductors and Electronic Crystals

In April 1983, EPA promulgated the Phase I E&EC ELGs for Subpart A (Semiconductors) and Subpart B (Electronic Crystals) (U.S. EPA, 1983a). As part of this rulemaking, EPA gathered industry analytical data to characterize wastewater discharges from semiconductor and electronic crystal manufacturing. EPA excluded 95 pollutants from regulation because they were 1) non-detectable with 1983 EPA analytical methods (82 pollutants), 2) present in concentrations too small to be effectively treated (antimony, beryllium, cadmium, mercury, selenium, thallium, zinc, and cyanide), or 3) subject to Metal Finishing ELGs (nickel, copper, chromium, and lead).[44] EPA ultimately established limitations for fluoride, toxic organics, arsenic, pH, and total suspended solids.[45] Since semiconductor and electronic crystal manufacturers use a wide variety of solvents, EPA identified several toxic organics that may be present in the untreated wastewater. Therefore, EPA established limitations for total toxic organics (TTO). EPA defined TTO, for Subparts A and B, as the sum of toxic organics listed in Table 5-7 with flow weighted mean concentrations greater than or equal to 0.01 milligrams per liter (mg/L) per pollutant (U.S. EPA, 1983a).

[44] See Section 5.2.1.4 for a discussion on the overlap between the E&EC and Metal Finishing ELGs.
[45] The E&EC ELGs reference the regulated pollutants for each subpart as the only pollutants of concern identified during the rulemaking (U.S. EPA, 1983a, 1983b).

Table 5-7. TTO Pollutants for Subpart A (Semiconductors) and Subpart B (Electronic Crystals)

List of TTO Pollutants for Semiconductors and Electronic Crystals			
anthracene	1,3-dichlorobenzene	Isophorone	toluene
bis(2-ethylhexyl)phthalate	1,4-dichlorobenzene	methylene chloride	1,2,4-trichlorobenzene
butyl benzyl phthalate	Dichlorobromoethane	naphthalene	1,1,1-trichloroethane
carbon tetrachloride	1,2-dichloroethane	2-nitrophenol	1,1,2-trichloroethane
chloroform	1,1-dichloroethylene	4-nitrophenol	trichloroethylene
2-chlorophenol	2,4-dichlorophenol	pentachlorophenol	2,4,6-trichlorophenol
di-n-butyl phthalate	1,2-diphenylhydrazine	phenol	
1,2-dichlorobenzene	ethyl benzene	tetrachloroethylene	

Source: (U.S. EPA, 1983a).

5.2.1.2 Phase II: Cathode Ray Tubes and Luminescent Materials

In December 1983, EPA promulgated the Phase II E&EC ELGs for Subpart C (CRTs) and Subpart D (Luminescent Materials) (U.S. EPA, 1983b). EPA gathered industry analytical data to characterize wastewater discharged from the manufacture of CRTs and luminescent materials. EPA originally divided the Electron Tube subcategory into CRTs and Receiving and Transmitting Tubes (RTT) subcategories; however, RTT manufacturing operations do not discharge wastewaters and only promulgated limitations for CRTs. Further, EPA did not establish limitations for existing source direct dischargers in the CRT subcategory. Only one facility directly discharged, and it operated a chemical precipitation plus filtration treatment system and the discharge of toxic pollutants was less than two pounds per day after current treatment. Similarly, EPA did not establish limitations or pretreatment standards for existing dischargers in the Luminescent Materials subcategory due to the small number of facilities in the subcategory (five) and because the amount of toxic metals discharged to surface water (less than one pound per facility per day) and toxic pollutants introduced to publicly operated treatment works (POTWs) was insignificant at the time of promulgation (U.S. EPA, 1983b).

For CRT manufacturing, EPA excluded 116 pollutants from regulation because they were either non-detectable with 1983 EPA analytical methods (106 pollutants) or present in concentrations too small to be effectively treated (antimony, arsenic, beryllium, copper, mercury, nickel, selenium, silver, thallium, cyanide) (U.S. EPA, 1983b). EPA established limitations for cadmium, chromium, lead, zinc, TTO, fluoride, pH, and total suspended solids for the CRT manufacturing subcategory. Similar to semiconductors and electronic crystals, CRT manufacturers use a wide variety of solvents, and EPA identified several toxic organics that may be present in the untreated wastewater. Therefore, EPA established limitations for TTO. For the CRT subcategory, EPA defined TTO as the sum of the toxic organics listed in Table 5-8 with flow weighted concentrations greater than or equal to 0.01 milligrams per liter (mg/L) per pollutant (U.S. EPA, 1983b).

Table 5-8. TTO Pollutants for Subpart C (CRTs)

List of TTO Pollutants for CRTs		
chloroform	methylene chloride	1,1,1-trichloroethane
bis(2-ethylhexyl) pthalate	Toluene	trichloroethylene

Source: (U.S. EPA, 1983b).

For luminescent material manufacturing, EPA excluded 123 pollutants from regulation because they were either non-detectable with 1983 EPA analytical methods (114 pollutants) or present in concentrations too small to be effectively treated (arsenic, beryllium, copper, mercury, nickel, selenium, silver, thallium, cyanide). EPA established limitations for cadmium, antimony, zinc, fluoride, pH, and total suspended solids for the luminescent material subcategory (U.S. EPA, 1983b).

5.2.1.3 Wastewater Treatment Technology Bases for Pollutant Limitations in the E&EC Category

The E&EC ELGs established pollutant limitations for the E&EC Category generally based on solvent management[46] (to control TTO), neutralization, chemical precipitation with clarification (hydroxide), in-process control for specific pollutants,[47] and filtration. As previously stated, EPA did not establish BPT, BAT, and BCT limitations for CRTs or luminescent materials, or PSES for luminescent materials. Table 5-9 presents the general wastewater treatment technology basis by subcategory and level of control.

Table 5-9. Wastewater Treatment Technology Bases for the E&EC Category

Subpart	Subcategory	Solvent Management	Neutralization	Chemical Precipitation with Clarification[a]	In-Process Control for Lead and Chromium	Filtration
BPT (Best Practicable Control Technology)						
A	Semiconductors	✓	✓			
B	Electronic Crystals	✓	✓	✓		
BAT (Best Available Technology Economically Achievable)						
A	Semiconductors	✓	✓	✓		
B	Electronic Crystals	✓	✓	✓		
BCT (Best Conventional Pollutant Control Technology)						
A	Semiconductors	✓	✓			
B	Electronic Crystals	✓	✓	✓		

[46] In the E&EC ELGs, EPA defined solvent management as a practice of preventing spent solvent baths (containing TTO) from entering other process wastewater. While the ELGs allow for some solvent bath contamination (e.g., drag out), plants are required to transfer solvent baths to drums or tanks for disposal.

[47] In-process control includes the collection of lead- and chromium- bearing wastes for resale, reuse, or disposal.

Table 5-9. Wastewater Treatment Technology Bases for the E&EC Category

Subpart	Subcategory	Solvent Management	Neutralization	Chemical Precipitation with Clarification[a]	In-Process Control for Lead and Chromium	Filtration
PSES (Pretreatment Standards for Existing Sources)						
A	Semiconductors	✓				
B	Electronic Crystals	✓	✓	✓		
C	Cathode Ray Tubes	✓	✓	✓	✓	
NSPS (New Source Performance Standards)						
A	Semiconductors	✓	✓	✓		
B	Electronic Crystals	✓	✓	✓		
C	Cathode Ray Tubes	✓	✓	✓	✓	✓
D	Luminescent Materials		✓	✓		
PSNS (Pretreatment Standards for New Sources)						
A	Semiconductors	✓				
B	Electronic Crystals	✓	✓	✓		
C	Cathode Ray Tubes	✓	✓	✓	✓	✓
D	Luminescent Materials		✓	✓		

Source: (U.S. EPA, 1983a, 1983b)

[a] EPA based all subparts on end-of-pipe or final effluent chemical precipitation with clarification except Subpart A (Semiconductors), which was based on in-plant chemical precipitation and clarification of the concentrated fluoride stream. In addition, contract hauling of the concentrated fluoride stream was considered an acceptable alternative for compliance.

5.2.1.4 Other Point Source Categories Related to E&EC

As stated above, EPA promulgated the existing E&EC ELGs (40 CFR Part 469) in 1983. EPA also promulgated the Electroplating ELGs in 1974 and amended them in 1977, 1979, 1981 and 1983 (40 CFR Part 413) and promulgated the Metal Finishing ELGs in 1983 (40 CFR Part 433). During promulgation of the E&EC and Metal Finishing ELGs and the amendments of the Electroplating ELGs, EPA considered that some facilities may generate wastewater from metal finishing and/or electroplating operations as well as E&EC operations; and therefore, facilities may be covered under multiple ELGs.

The Metal Finishing ELGs apply to discharges resulting from six core process operations, and 40 additional process operations for those facilities using at least one of the six core process operations (U.S. EPA, 1983c). The six core metal finishing process operations are electroplating, electroless plating, anodizing, coating, etching and chemical milling, and printed circuit board manufacturing (U.S. EPA, 1983c). Following the amendments of the Electroplating ELGs, EPA limited the applicability of the Electroplating Category ELGs to facilities that apply metal coatings via electrodeposition that began operation before July 15, 1983, and discharge wastes to

POTWs. All other facilities performing electroplating operations are subject to regulations under the Metal Finishing Category (U.S. EPA, 1983c).

As discussed in later sections, most semiconductor manufacturing facilities use one or more of the six core metal finishing operations while processing silicon wafers. The *Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Metal Finishing Point Source Category* states that the ELGs for the Metal Finishing Category, the Electroplating Category, and/or the E&EC Category cover all industries listed under SIC Major Group 36.[48] Specifically, the E&EC ELGs cover processes unique to electronics manufacturing (e.g., semiconductor manufacturing, electronic crystal production), while the Metal Finishing and Electroplating ELGs cover the remaining processes used to manufacture the products in SIC Major Group 36 (U.S. EPA, 1983c).

As described in the *Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Metal Finishing Point Source Category*, when overlap occurs between the Metal Finishing or Electroplating ELGs and E&EC ELGs, the Metal Finishing ELGs apply for the discharge of four pollutants (nickel, copper, chromium, and lead) (U.S. EPA, 1983c). For example, for a semiconductor manufacturing facility generating electroplating wastewater, the subpart A E&EC ELGs would apply for pollutants provided in Table 5-6 and the Metal Finishing ELGs would apply for four pollutants associated with metal finishing processes (nickel, copper, chromium, and lead). Note that EPA is currently conducting a preliminary study of the Metal Finishing Category; for more information, see the *Preliminary Study of the Metal Finishing Category: 2015 Status Report* (U.S. EPA, 2016a).

5.2.2 E&EC Industry Profile

As part of the current review, EPA reviewed the 1983 E&EC industry profile and updated the characteristics of the current E&EC industry. This section presents the facility type, wastewater discharge practices, and process operations for E&EC facilities in 1983 and currently. Section 5.2.3 presents information on E&EC wastewater characteristics, and Section 5.2.4 presents information on E&EC wastewater treatment technologies.

5.2.2.1 1983 E&EC Industry Profile

EPA developed an industry profile for the E&EC industry as part of the development of the Phase I and Phase II E&EC ELGs in 1983. To complete the industry profile, EPA gathered information through literature searches, EPA regional office contacts, wastewater treatment technology vendors, and plant surveys and evaluations. This section describes the 1983 facility information EPA gained from its data collection efforts.

Facilities and Wastewater Discharge Practices

During the 1983 E&EC rulemaking, EPA identified that the majority of facilities under the E&EC Category manufactured semiconductors (Subpart A) (approximately 72 percent). EPA estimated that about 20 percent of facilities within the E&EC Category manufactured electronic crystals (Subpart B), leaving approximately 8 percent of facilities under Subparts C (CRTs) and

[48] SIC Major Group 36 includes Semiconductor and Related Manufacturing (SIC code 3674), Electron Tube Manufacturing (SIC code 3671), and Electronic Component Manufacturing (SIC code 3679).

D (luminescent materials). Table 5-10 provides the facility count and discharge type identified during the 1983 E&EC rulemaking.

Table 5-10. Facility Information for 1983 Industry Profile

Subpart	Manufacturing Process	Facility Count[a]	Dischargers	
			Direct	*Indirect*
A	Semiconductor Manufacturing	257	77	180
B	Electronic Crystals	70	6	64
C	Cathode Ray Tubes	24	1	23
D	Luminescent Materials	5[b]	2	2
Total		**356**	**86**	**269**

Source: (U.S. EPA, 1983a, 1983b)

[a] EPA identified the number of facilities using a Semiconductor Industry Association (SIA) listing of plants involved in manufacturing semiconductor products in August 1979.

[b] EPA identified one facility with zero discharges.

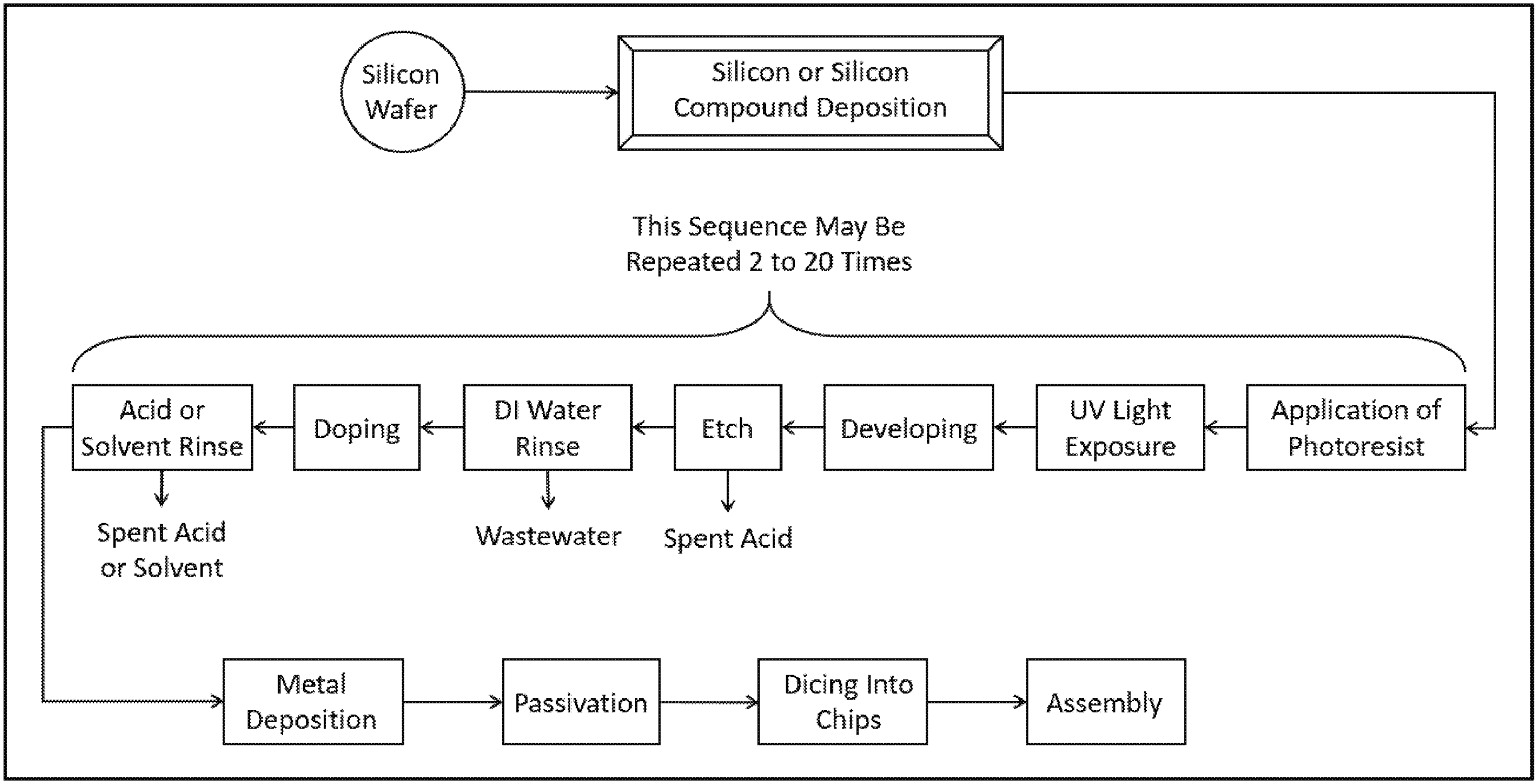
As shown in Table 5-10, in 1983, 76 percent of all facilities in the E&EC industry discharged to POTWs, including 70 percent of semiconductor manufacturing facilities, 91 percent of electronic crystal manufacturers, and 96 percent of CRT manufacturing facilities. EPA only reviewed five luminescent materials manufacturers, where 40 percent discharged to surface waters and 40 percent discharged to POTWs, while 20 percent achieved zero discharge (U.S. EPA, 1983a, 1983b).

E&EC Process Operations

EPA reviewed information on the process operations for the four subcategories established in 1983: semiconductor manufacturing, electronic crystal manufacturing, cathode ray tube manufacturing, and luminescent materials manufacturing. The following sections summarize the results by subcategory.

Semiconductor Manufacturing

In general, semiconductor manufacturing facilities coat and chemically etch/pattern silicon wafers for the desired E&EC products. In 1983, semiconductor manufacturing involved a series of processes, possibly repeated two to 20 times, starting from a raw silicon wafer and ending in a chip designed for assembly in a specific electronic product. Figure 5-2 presents the sequence of process operations for manufacturing silicon integrated circuits (a semiconductor type), as identified in 1983.

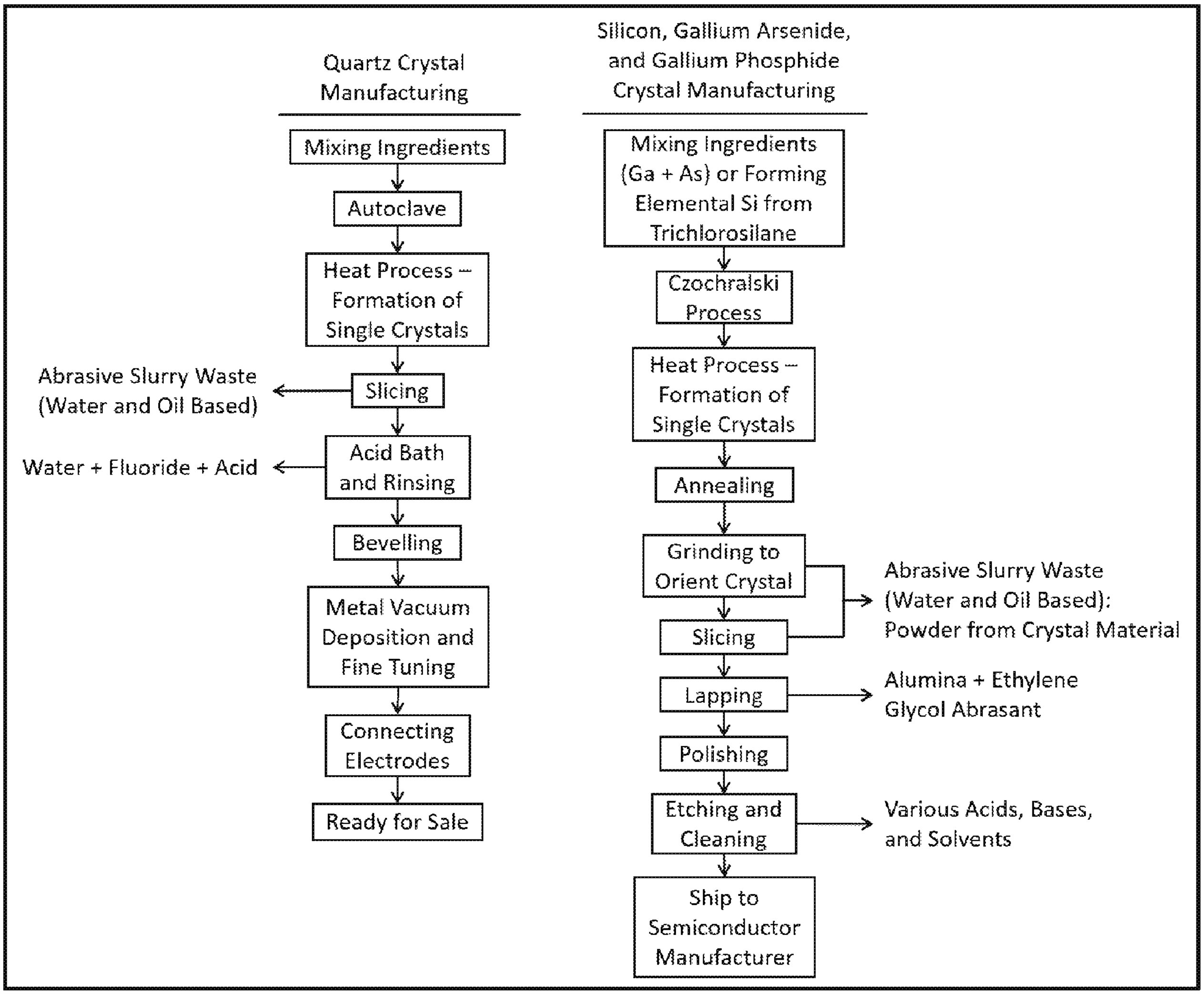


Source: Adapted from (ERG, 2016a; U.S. EPA, 1983a)

Figure 5-2. 1983 Silicon Integrated Circuit Production

Electronic Crystals Manufacturing

EPA defined electronic crystal manufacturing as the growing of crystals and/or production of crystal wafers for use in the manufacture of electronic devices. In general, electronic crystal manufacturing involves forming a crystalline boule and then slicing, rinsing, lapping (e.g., grinding), polishing, etching, and cleaning the crystal prior to shipping to a semiconductor manufacturer or another electronics customer. Figure 5-3 shows diagrams of typical manufacturing process flows in 1983 for the manufacture of quartz crystals (a type of piezoelectric crystal), and three types of semiconducting crystals; silicon, gallium arsenide, and gallium phosphide. EPA only identified one sapphire crystal producer in 1983; therefore, sapphire crystal manufacturing was not a focus of the rulemaking. EPA reviewed sapphire crystal manufacturing as part of the 2015 Annual Review. Although this review suggested that sapphire crystals are currently a common type of electronic crystal manufactured and used in the E&EC industry (U.S. EPA, 1983a, 2016b).



Source: Adapted from (U.S. EPA, 1983a).

Figure 5-3. Basic Manufacturing Processes for Electronic Crystals in 1983

Cathode Ray Tubes and Luminescent Materials Manufacturing

In 1983, CRT manufacturing operations differed depending on the type of CRT (e.g., color television (TV) tubes, single phosphor tubes). The manufacture of each type of CRT was highly complex and often automated (U.S. EPA, 1983b). The 1983 E&EC ELGs define luminescent materials as "those that emit electromagnetic radiation (light) upon excitation by such energy sources as photons, electrons, applied voltage, chemical reactions, or mechanical energy. These luminescent materials are used for a variety of applications, including fluorescent lamps, high-pressure mercury vapor lamps, color TV picture tubes and single phosphor tubes, lasers, instrument panels, postage stamps, laundry whiteners, and specialty paints" (U.S. EPA, 1983b). EPA based its 1983 analyses related to these two subcategories on those materials used as coatings in fluorescent lamps and color TV picture tubes and single phosphor tubes (U.S. EPA, 1983b).

5.2.2.2 Existing E&EC Industry Profile

As a first step in understanding the existing industry profile, EPA identified the relevant North American Industry Classification System (NAICS) and Standard Industrial Classification (SIC) codes that cover electronics and electrical component manufacturing facilities. Specifically, EPA reviewed the NAICS-Point Source Category (NAICS-PSC) and SIC-PSC crosswalks developed for the 304m Annual Review process,[49] the E&EC ELGs development documents, and the SIC industry Group 367 (Electronic Components and Accessories). From this review, EPA identified four NAICS codes and three SIC codes that correspond to facilities that may currently fall under the E&EC Category. Table 5-11 presents these NAICS and SIC codes.

Table 5-11. NAICS and SIC Codes Under the E&EC Category

Potential Applicable Subpart[a]	NAICS Code	NAICS Code Description	SIC Code	SIC Code Description
A, B	334413	Semiconductor and Related Device Manufacturing	3674	Semiconductor and Related Devices
A	333242	Semiconductor Machinery Manufacturing	NA	NA
C, D	NA	NA	3671	Electron Tubes
B, C, D	334419[b]	Other Electronic Component Manufacturing	3679	Electronic Components, Not Elsewhere Classified

NA: Not applicable.

[a] EPA performed best professional judgement based on current knowledge of reported facility discharges to link the E&EC Category subpart to the corresponding NAICS and SIC code. Note that not all facilities classified under these NAICS and/or SIC codes will have associated wastewater discharges, or their discharges may not be covered under the identified E&EC Category subpart.

[b] In 2012, the U.S. Census Bureau discontinued NAICS code 334411 (Electron Tube Manufacturing), and consolidated all Electron Tube Manufacturing facilities under NAICS code 334419 (U.S. Census Bureau, 2016a).

[49] For further information on the NAICS-PSC and SIC-PSC crosswalks see the *Technical Support Document for the Annual Review of Existing Effluent Guidelines and Identification of Potential New Point Source Categories* (U.S. EPA, 2009).

Using the NAICS and SIC codes identified above as a starting point, EPA gathered information about the existing E&EC industry, including number of facilities, existing operations, and discharge practices. Specifically, for its review of the existing industry profile, EPA:

- Evaluated the most recent U.S. Census Bureau Economic Statistics (economic census data) for the relevant NAICS codes.
- Downloaded and analyzed 2014 Discharge Monitoring Report (DMR) and Toxics Release Inventory (TRI) data for the relevant SIC and NAICS codes. Specifically, EPA extracted data from *TRILTOutput2014_v1* and *DMRLTOutput2014_v1*. Section 2.1 provides EPA's methodology for obtaining the DMR and TRI data and generating these databases.
- Reviewed E&EC Industry IBISWorld Reports for Semiconductor and Circuit Manufacturing (33441a) and Circuit Board and Electronic Component Manufacturing (33441b).
- Searched and downloaded available E&EC facility NPDES permits.
- Identified and reviewed information from a literature search. Appendix B presents details on the keyword searches used for the literature review.

In addition to reviewing the publicly available data sources listed above, EPA spoke with facility contacts, attended industry conferences, and held discussions with trade associations and POTW organizations. Specifically, EPA attended two annual conferences in 2016 held by the Semiconductor Equipment and Materials International (SEMI) trade association: the Advanced Semiconductor Manufacturing Conference (ASMC) SEMI Conference in Saratoga Springs, New York, and the SEMI Conference (SEMICON) West in San Francisco, California. The conferences provided information about trends, environmentally conscious practices, materials, and manufacturing processes in the semiconductor industry. EPA held discussions with the Semiconductor Industry Association (SIA), which provided information on the current state of semiconductor manufacturing. Specifically, SIA provided insight on how the semiconductor industry has changed since 1983 in terms of manufacturing processes generating wastewater, trends, new technologies, facility information, materials, process equipment, wastewater treatment, and discharge practices, and offered their perspective on the E&EC ELGs. EPA also met with NACWA members to discuss their experience with implementing the E&EC pretreatment standards and to identify any unique wastewater characteristics from new E&EC process operations that present challenges to POTWs (U.S. EPA, 2016c).

EPA evaluated the data collected from these efforts for their usefulness and quality in accordance with *The Environmental Engineering Support for Clean Water Regulations Programmatic Quality Assurance Project Plan (PQAPP)* (ERG, 2013). Appendix A provides details on data usability and the quality of data sources supporting the current review.

This section presents EPA's current understanding of the E&EC industry's profile, including E&EC facilities, discharge practices, market statistics, and operations.

Facilities and Wastewater Discharge Practices

EPA evaluated several data sources to identify the number, size, and type of facilities currently in the E&EC industry. Specifically, EPA reviewed DMR and TRI industrial wastewater discharge data, U.S. Economic Census data, and IBISWorld Industry Reports.

To understand the universe of E&EC facilities reporting wastewater discharges, as well as their discharge practices, EPA extracted the 2014 DMR and TRI data for the SIC and NAICS codes in the E&EC Category from *TRILTOutput2014_v1* and *DMRLTOutput2014_v1*, respectively, and identified the total number of direct and/or indirect dischargers for each industry code. The DMR and TRI datasets provide the most comprehensive source of information on existing wastewater discharges in the U.S. See Section 2.1 of this report for details on the utility and limitations of the DMR and TRI data and for EPA's methodology for obtaining the DMR and TRI data and generating these databases. In addition, EPA identified the total number of companies and facilities under each NAICS code using U.S. Economic Census data. Table 5-12 presents the U.S. Census company and facility counts as well as information on the discharge practices (direct, indirect, or both) for facilities with reported wastewater discharges to DMR and/or TRI by relevant NAICS (and SIC code, where applicable).

Table 5-12. Facility Information for the Existing Industry Profile

Potential Applicable Subpart[a]	NAICS (SIC) Code	Industry Description	U.S. Census Company Count[b]	U.S. Census Facility Count[c]	Dischargers (As Reported on DMRs and/or to TRI)			
					Total	*Direct*	*Indirect*	*Both*
A, B	334413 (3674)	Semiconductor and Related Device Manufacturing	793	862	70	4	63	3
A	333242	Semiconductor Machinery Manufacturing	168	184	3	0	3	0
B, C, D	334419 (3679)	Other Electronic Component Manufacturing	1,170	1,110	20	5	14	1
Total			**2,130**	**2,160**	**93**	**9**	**80**	**4**

Source: TRILTOutput2014_v1; DMRLTOutput2014_v1; (U.S. Census Bureau, 2016b)

a EPA performed best professional judgement based on current knowledge of reported facility discharges to link the E&EC Category subpart to the corresponding NAICS and SIC code. Note that not all facilities classified under these NAICS and/or SIC codes will have associated wastewater discharges, or their discharges may not be covered under the identified E&EC Category subpart.

b The "Company Count" represents E&EC parent companies based on 2012 Economic Census data, the most recent available data compiled for parent companies.

c The "Facility Count" represents E&EC establishments based on 2014 Economic Census data, the most recent available data compiled for establishments.

As shown in Table 5-12, EPA identified 93 facilities with 2014 DMR and/or TRI discharges greater than zero out of over 2,000 E&EC facilities in the U.S., according to the most recent economic census data. However, EPA notes that the large difference between the facility counts could be attributed to facilities that include, but are not limited to: (1) facilities listed in the U.S. Economic Census data that are distributors or sales facilities, not manufacturers; (2) facilities that do not meet TRI-reporting thresholds; and (3) facilities that are classified as minor dischargers in DMR, and therefore are not captured in the DMR data. In addition, EPA notes the limitations of the DMR and TRI datasets (as discussed in Section 2.1). [50]

From review of the data sources listed above, EPA identified that the universe of dischargers in the E&EC industry appears to have decreased since 1983, however, EPA notes the apparent decrease may be attributed to some extent by the limitations of the DMR and TRI data, as they are not comprehensive of all discharges (see Section 2.1 for data source limitations). Additionally, the 1983 data is likely more inclusive as the information was provided directly from industry trade associations and may include small facilities not otherwise captured in the publicly available DMR and TRI data. EPA also identified that the overall discharge practices remain similar, with most facilities discharging to POTWs. The 2014 DMR and TRI data indicate that 10 percent of the facilities with reported discharges discharge directly to surface waters, 4 percent discharge to both surface waters and to a POTW, and 86 percent discharge to a POTW (see Table 5-12). While the publicly available data (i.e., DMR and TRI data) do not provide a complete profile of the E&EC industry, the existing profile indicates substantially fewer direct dischargers in the industry than in 1983, suggesting an industry-wide trend toward indirect discharge. EPA's discussions with SIA also indicated that no zero discharge semiconductor facilities exist in the U.S. to their knowledge, due to the difficulty of reusing waste streams and the necessity of using ultra-pure water for several process operations (ERG, 2016a).

To supplement EPA's understanding of the current E&EC industry, EPA also evaluated two 2016 IBISWorld Industry Reports for the U.S. E&EC industry: *Semiconductor and Circuit Manufacturing* (334411a) and *Circuit Board and Electronic Component Manufacturing* (33441b). The first report, *Semiconductor and Circuit Manufacturing*, estimates that there are 724 companies in the semiconductor and circuit manufacturing industry in 2016. This is similar to the U.S. economic census data estimate of 793 semiconductor manufacturing companies in 2012 (shown in Table 5-12). The second report, *Circuit Board and Electronic Component Manufacturing*, estimates that there are 2,758 circuit board and electronic component manufacturing companies in 2016, divided into the following products and/or service categories (IBISWorld, 2016a, 2016b):

- 40.1 percent printed circuits.
- 28.1 percent other electronic components.
- 13.0 percent electronic connectors.
- 10.4 percent bare printed circuit board.
- 8.4 percent capacitors, resistors, coils, and transformers.

These categories likely include facilities that also fall under the Metal Finishing Category. In addition, EPA recognizes that the E&EC Category may only cover facilities

[50] Further discussion of the scope and limitations of the DMR and TRI datasets is available in the 2015 Annual Review Report (U.S. EPA, 2016b).

manufacturing products under the "other electronic components" category, or approximately 775 facilities.

Both IBISWorld Reports show that the top two E&EC manufacturing states are California and Texas, with over 25 percent of the establishments, combined (IBISWorld, 2016a, 2016b). EPA also evaluated the location of E&EC facilities reporting discharges to DMR or TRI in 2014 and, consistent with IBISWorld data, estimated that over 25 percent of those E&EC facilities are located in California or Texas.[51]

The U.S. Economic Census and IBISWorld report data convey that there are currently between 700 and 800 semiconductor manufacturing companies in the U.S. However, EPA has identified a data gap in its current understanding of the discharge practices of these semiconductor manufacturing facilities as well as other types of E&EC facilities, based on the limitations of the publicly available DMR and TRI data. Therefore, EPA cannot at this time definitively estimate the number of existing facilities under the E&EC Category with wastewater discharges; although the available data do indicate that the E&EC industry is primarily comprised of semiconductor manufacturing facilities and facilities discharging to POTWs. Additionally, the E&EC industry likely has few, if any, zero discharging facilities, based on discussions with SIA and NACWA (ERG, 2016a; U.S. EPA, 2016c).

E&EC Market Statistics and Trends

To further understand changes in the E&EC market over time, EPA reviewed information provided by SIA, presented at industry conferences, and discussed in the IBISWorld Reports for the E&EC industry. SIA estimates that the global semiconductor market has grown from $21 billion in 1986 to $335 billion in 2015 (ERG, 2016a). In addition, the IBISWorld Report values the U.S. Semiconductor and Circuit Manufacturing industry at $54.2 billion in 2016 (IBISWorld, 2016a). While the semiconductor industry is globalized, more than 50 percent of U.S. headquartered firms' semiconductor manufacturing capacity is in the U.S. (ERG, 2016a).

Several speakers at the ASMC SEMI and the SEMICON West conferences also focused presentations and discussion on how the Internet of Things (IoT) will affect every economic sector (e.g., manufacturing, real estate, agriculture, retail, and transportation). IoT links the physical world (e.g., machinery, buildings, vehicles) to the digital world via electronics, sensors, and network connectivity. The semiconductor industry is essential to the digital world because IoT process control technologies, factory digitization, virtual manufacturing, and digital services will rely on new semiconductor designs and applications. Therefore, the semiconductor industry is expected to see increasing demand for products associated with IoT (ERG, 2016b, 2016c; Marone, 2016).

In contrast, the IBISWorld Report states that the Circuit Board and Electronic Component Manufacturing industry sector, which produces printed circuits, other electronic components, electronic connectors, bare printed circuit boards, capacitors, resistor coils, and transformers, is in the decline phase of its life cycle. In the decline phase, typically industry revenue grows slower than the economy, large firms control a majority of the industry,

[51] All facilities under the NAICS and/or SIC codes listed in Table 5-11 reporting a pollutant load greater than zero pounds per year.

technology and processes do not change significantly, and per capita consumption of industry products decreases (IBISWorld, 2016b). The circuit board and electronic component manufacturing industry sector produces several products that may not fall under the applicability of the E&EC ELGs. For example, printed circuits most likely fall under the applicability of the Metal Finishing category. Moreover, IBISWorld estimates that product demand will continue to decline for specific markets. For instance, electron tubes (e.g., CRTs), which fall under the "other electronic components" product designation in the IBISWorld Circuit Board and Electronic Component Manufacturing Industry, accounted for less than 1.5 percent of the industry revenue over the past five years, mostly due to their obsolescence (IBISWorld, 2016b).

E&EC Process Operations

Since 1983, EPA has observed changes in E&EC process operations in all four subcategories. EPA evaluated economic census data, analyzed DMR and TRI data, performed a literature search, searched for available NPDES reports, reviewed IBISWorld reports, met with industry trade associations and NACWA members, contacted individual facilities, and attended industry conferences, to identify the nature of current E&EC process operations (see the introduction to Section 5.2.2.2 for data collection methods). The following sections summarize the results by subcategory.

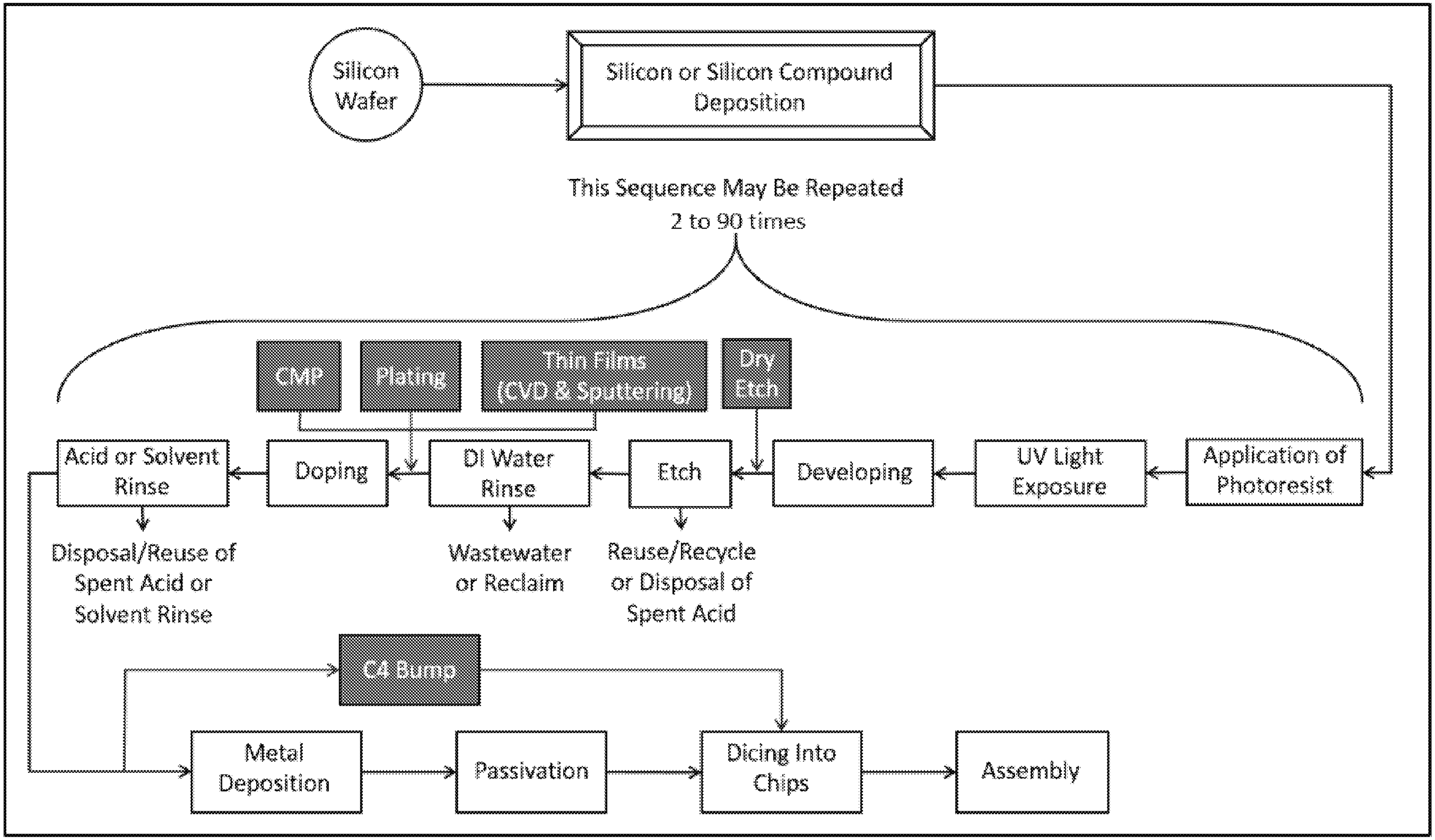
Semiconductor Manufacturing

Discussion with SIA indicated that while the semiconductor manufacturing (Subpart A) process sequence has not changed significantly, semiconductor manufacturing facilities (the semiconductor manufacturing industry refers to these facilities as fabrication plants or "fabs") have added several process steps over the past 30 years to optimize semiconductor manufacturing, incorporate newer technologies, and achieve smaller node size. The node size, which indicates how densely individual transistors can be packed on a chip, has decreased approximately every two years since 1970, thereby doubling the number of transistors per square inch. The E&EC Industry refers to this observation as Moore's Law (ERG, 2016b). When the number of transistors on a chip increases, the computational capabilities increase, speed increases, and energy consumption decreases. Since 2010, the node size decreased from 32 nanometers (nm), to 22 nm, to 14 nm, and now 10 nm (estimated for 2017 operations) (ERG, 2016a, 2016b).

In addition to the node size decreasing, the semiconductor industry has increased the silicon wafer size over the past 30 years, from a diameter of 125 millimeters (mm), to 200 mm, to 300mm, and now 450mm (estimated for 2017 operations) (ERG, 2016a, 2016b). By seeking to decrease the node size and increase the wafer size as much as feasible, the industry continually increases the number of microprocessors obtainable from a single wafer, to the limits of the technology available (Aldrich, 2016). Furthermore, as the technology advances, semiconductor manufacturing facilities must replace machines, tools, and monitoring systems to support new processes.

More specifically, to increase the number of microprocessors obtainable from a single wafer over the past 30 years, semiconductor manufacturing facilities have integrated new steps within the semiconductor manufacturing process sequence including dry etching, metal deposition processes (e.g., plating, chemical vapor deposition (CVD), copper metallization), chemical mechanical planarization (CMP), and controlled collapse chip connection (C4) bump. SIA indicated that wastewater is generated from these new processes but did not provide further details. In addition to new process steps, SIA stated that the existing semiconductor process sequence could be repeated up to 90 times, whereas in 1983 the sequence was repeated only up to 20 times. Therefore, the existing semiconductor process sequence could potentially generate greater volumes of wastewater due to the repetition of process steps and necessity for ultrapure water (i.e., rinse water cannot always be recycled because of the high-water quality requirement). Figure 5-4 provides the 1983 process flow diagram from the E&EC ELGs with updated semiconductor manufacturing operations based on EPA's discussions with SIA (ERG, 2016a; U.S. EPA, 1983a, 1998). In discussions with NACWA members, one member stated that semiconductor manufacturing evolves rapidly, and companies may tear down one semiconductor manufacturing facility to build another in a year. In addition, the NACWA member stated that process chemistries used in semiconductor manufacturing can be facility and/or product-specific and may not be consistent across the industry nationwide.

To further understand existing processes, EPA contacted six semiconductor facilities. EPA identified these facilities by evaluating available DMR and TRI data from *TRILTOutput2014_v1* and *DMRLTOutput2014_v1* for NAICS/SIC code listed in Table 5-11. EPA focused on facilities discharging the highest toxic weighted-pound equivalents (TWPE) based on reported 2014 DMR and TRI data. For facilities with the highest TWPE identified from the TRI data, EPA prioritized those that based their TRI releases on monitoring data (rather than using other estimation strategies). EPA inquired about the facility's age, size, manufacturing processes, end-products, process chemistries, wastewater generation, and wastewater treatment technologies. Table 5-13 presents a summary of information EPA obtained from these facility contacts. The facility contacts generally stated that the final products in semiconductor manufacturing have continued to shrink in size causing some fabrication processes to change (e.g., tooling, lithography patterns, new coating layers, CVD) (Aldrich, 2016; Heironimus, 2016; McCoy, 2016). Most of the contacts indicated that process chemistries (i.e., chemicals used in E&EC processes) have not changed substantially over the past 30 years; however, one facility stated that the chemistry changes would likely involve trading out one acid for another acid (McCoy, 2016).



Source: Adapted from (ERG, 2016a).
Note: Process steps in black writing and grey boxes represent the 1983 semiconductor manufacturing operations and process steps in white/red writing and red boxes represent updated semiconductor manufacturing operations since 1983.

Figure 5-4. Updated Silicon Integrated Circuit Production

Table 5-13. Summary of Facility Contacts for the Semiconductor Industry

Facility Name	Location	Manufacturing Process	Year/ Age	Size[a]	Type	Wastewater Generation Processes	Wastewater Treatment[b]
East Fishkill Facility	Hopewell Junction, NY	Semiconductor 300 mm fab	1963 53 yrs	40 MGD 168,000 wafers/yr	Direct	• Ultrapure water reject • Photolithography (i.e., solvents, rinses) • Polishing	• Clarifiers • CP (polymer) • Microfiltration • Acid base slurry treatment • Calcium hydroxide precipitation (Fluoride treatment) • Recycle 10 to 11 million gal/month (i.e., for use in 2nd/3rd rinses)
Powerex, Inc.	Youngwood, PA	Semiconductor	1965 51 yrs	0.1 MGD	Direct	• Rinsing after etching • Cleaning products throughout process	• Contact did not provide wastewater treatment information.
Micron Technology, Inc.	Manassas, VA	Semiconductor 300 mm fab	1997 19 yrs	200 MGD	Both	• Throughout manufacturing process (rinse water)	• Clarifiers • pH adjustment • Chloride treatment • Lime addition with filter tank
Samsung Austin Semiconductor	Austin, TX	Semiconductor	1996 20 yrs	1.3 billion gal/yr	Indirect	• Ultrapure water reject • Rinsing after etching • Cleaning products throughout process	• Clarifiers • CP (sodium hydroxide, lime, caustic, sulfuric acid, ferric chloride) • Filter presses • *Future Wastewater Treatment:* Ion Exchange (Cu Treatment)[c]
Freescale Semiconductor – Oak Hill Facility	Austin, TX	Semiconductor	1991 25 yrs	240,000 wafers/yr	Indirect	• Ultrapure water reject • Rinsing after etching	• pH adjustment • Recycle a portion of rinse water (i.e., for use in cooling tower, scrubber)
Intel Corporation	Chandler, AZ	Semiconductor 12 in wafer	1994 22 yrs	5.4 MGD	Indirect	• Wet edging • Abatement technologies • Rinsing after etching • Cleaning products throughout process	• Fluoride Treatment (i.e., creates calcium fluoride cake) • Stripper scrubber (NH_3 Treatment) • Zeolite resin (NH_3 Treatment) • Electrowinning System (Cu Treatment)

Source: (Aldrich, 2016; Heironimus, 2016; Kang, 2016; Marone, 2016; McCoy, 2016; Wasielewski, 2016).

[a] MGD – million gallons per day discharged; Production rate (i.e., number of wafers).

[b] CP – Chemical Precipitation.

[c] Future Wastewater Treatment – The facility is considering installing ion exchange for copper treatment in effluent (i.e., performing pilot studies).

Electronic Crystals Manufacturing

EPA reviewed electronic crystal manufacturing as part of the 2015 Annual Review and concluded sapphire crystal manufacturing has likely increased in the U.S. since the 1983 E&EC rulemaking. EPA also concluded that sapphire crystal wafer production generates wastewater in the form of slurries and acids from processing steps including wafer lapping, wafer grinding, and polishing similar to the processing steps for the production of other types of electronic crystals. Wafer lapping involves using an abrasive liquid slurry mixture to form a smooth, polished surface, while wafer grinding uses oil- or water-based slurries for coarse removal of material. Polishing slurries are used for surface polishing and removing abrasives; however, these slurries may introduce water, oil, and acid-based additives, as well as harsh chemicals, to the process wastewater. However, EPA's information on the wastewater constituents associated with sapphire crystal manufacturing is limited as the chemicals used in the preparation of sapphire wafers have not been thoroughly studied (U.S. EPA, 2016b).

For the current review, EPA conducted a targeted literature review using the keyword list found in Appendix B and did not identify any further information with regard to sapphire crystal manufacturing. However, EPA identified one paper with specific information regarding treatment of wastewater from electronic crystal polishing (Sturgill, et al., 2000). Sturgill primarily discusses pollution prevention and recycling of gallium and arsenic from gallium arsenide (GaAs) polishing wastes, but the introduction provides a general description of GaAs crystal manufacturing. Sturgill states that boules (i.e., ingots of crystalline GaAs) are cut into wafers, and then the wafers are etched, lapped, and polished (Sturgill, et al., 2000). Sturgill's GaAs crystal manufacturing process steps are similar to electronic crystal manufacturing process steps depicted in Figure 5-3 identified during the 1983 rulemaking. This information suggests the electronic crystal manufacturing process steps have not changed substantially over the past 30 years; however, as identified during the 2015 Annual Review, sapphire crystal manufacturing has likely increased.

Cathode Ray Tubes and Luminescent Materials Manufacturing

EPA reviewed existing manufacturing operations for Subpart C, CRTs, and Subpart D, luminescent materials, through internet searches and the literature review. The research indicates that CRT manufacturing has decreased dramatically due to their replacement with newer technologies, such as liquid crystal display (LCD), thin-film transistor liquid crystal display (TFT-LCD), plasma display, and organic light-emitting diode (OLED) for TV and other electronic applications (IBISWorld, 2016b; Sood & Tellis, 2005). Similarly, luminescent materials consisted of fluorescent lamp phosphors in 1983 (i.e., used in TV, video game displays, and lamp applications); however, most of these applications have been replaced with other technologies, such as light-emitting diode (LED) lamps and the CRT replacement technologies listed previously (ERG, 2016a; IBISWorld, 2016b; Sood & Tellis, 2005). In addition, NACWA members confirmed that CRT and luminescent materials are phasing out of production (U.S. EPA, 2016c).

5.2.3 E&EC Wastewater Characteristics

EPA evaluated several data sources to identify existing E&EC wastewater characteristics (see the introduction to Section 5.2.2.2 for data collection methodology). First, EPA analyzed publicly available data, such as the 2014 DMR and TRI data, to identify the types of pollutants that facilities reported as currently discharged. EPA analyzed these data to identify the number and percent of facilities reporting each pollutant, discharge type (e.g., direct, indirect, or both), pollutant load, and TWPE. Table 5-14 provides this information for facilities reporting 2014 DMR and/or TRI data and identifies whether E&EC ELGs establish limitations for the reported pollutant. As previously mentioned, EPA notes the limitations of the DMR and TRI datasets, as DMR data are limited to pollutants that a facility is required to monitor for in a discharge permit and TRI data are limited to pollutants on the TRI Chemicals list (see Section 2.1 of this report for details on the utility and limitations of the DMR and TRI data).

From the available DMR and TRI data, EPA identified 28 pollutants in E&EC wastewater discharges as summarized on Table 5-14. Of these pollutants, four have limitations established under the E&EC ELGs (i.e., lead, cadmium, chromium, and TSS) and eight have limitations established under the Metal Finishing ELGs (copper, lead, cadmium, chromium, nickel, cyanide compounds, TSS, and oil and grease), which may apply for E&EC facilities that have metal finishing operations. Further, more than 45 percent of facilities reported discharges of five pollutants (nitrate, lead, nitric acid, hydrogen fluoride, and n-methyl-2-pyrrolidone) of which lead is regulated under the CRT subcategory of the E&EC ELGs. However, as shown in Table 5-14, the overall discharge of each pollutant is small, except for nitrate, which accounts for approximately 60 percent of the total pounds discharged for the category. Although EPA did not identify additional pollutants of concern that could be removed by the technology bases evaluated for the 1983 ELGs (see Table 5-4 for information on the E&EC ELGs treatment technology bases), EPA notes that some of the pollutants listed in Table 5-14 may in fact be treated to some degree with current treatment in-place; however, EPA has not investigated the ancillary removal of additional pollutants at this time.

For the facilities reporting 2014 DMR data and included in Table 5-14, EPA attempted to collect publicly available NPDES permit documentation, but did not identify any relevant permits for analysis.

Table 5-14. Discharge Data for Pollutants Reported to 2014 DMR and TRI with Pollutant Load Greater than Zero

Pollutant	Count of Facilities Reporting Pollutant	Percent of Facilities Reporting Pollutant	Discharge Type	DMR	TRI	Pounds	TWPE	Pollutants with Limitations Under 1983 E&EC ELGs[a]
Nitrate	46	48%	Both		✓	2,180,000	1,630	-
Copper	22	23%	Both		✓	1,660	1,030	*
Ammonia as N	37	39%	Both	✓	✓	333,000	369	-
Sodium Dimethyldithiocarbamate	1	1%	Indirect		✓	2,380	190	-
Ethylene Glycol	22	23%	Both		✓	65,100	87.3	-
Total Residual Chlorine	7	7%	Direct	✓		146	73.1	-
Lead	80	84%	Both		✓	28	62.7	C*
Manganese	3	3%	Both	✓	✓	526	54.2	-
Cadmium	1	1%	Indirect		✓	1	22.8	C, D*
Certain Glycol Ethers	13	14%	Indirect		✓	135,000	14.4	-
Nitric Acid	54	57%	Indirect		✓	2,840	2.12	-
Chromium	2	2%	Both		✓	28	1.96	C*
Nickel	4	4%	Both		✓	17.3	1.73	*
Mercury	4	4%	Indirect		✓	0.00355	0.391	-
Catechol	1	1%	Indirect		✓	16.2	0.162	-
Hydrogen Fluoride	63	66%	Indirect		✓	11,600	0.0652	-
Trichloroethylene	3	3%	Direct	✓		3.55	0.0355	-
Iron	1	1%	Direct	✓		3.39	0.019	-
Cyanide Compounds	1	1%	Indirect		✓	0.45	0.00243	*
Xylene (Mixed Isomers)	5	5%	Indirect		✓	0.04	0.000173	-

Table 5-14. Discharge Data for Pollutants Reported to 2014 DMR and TRI with Pollutant Load Greater than Zero

Pollutant	Count of Facilities Reporting Pollutant	Percent of Facilities Reporting Pollutant	Discharge Type	DMR	TRI	Pounds	TWPE	Pollutants with Limitations Under 1983 E&EC ELGs[a]
Methylene chloride	1	1%	Direct	✓		0.024	0.0000243	-
1,1-Dichloroethane	1	1%	Direct	✓		0.0131	0.0000067	-
Total Dissolved Solids	1	1%	Direct	✓		736,000	-	-
N-Methyl-2-Pyrrolidone	45	47%	Indirect		✓	51,700	-	-
Total Suspended Solids	8	8%	Direct	✓		47,400	-	B, C, D*
Biochemical Oxygen Demand	6	6%	Direct	✓		8,550	-	-
Oil and grease	5	5%	Direct	✓		67.9	-	*
Phosphorus	1	1%	Direct	✓		18.8	-	-
Total	**95[b]**	**100%**				**3,580,000**	**3,540**	

Source: *TRILTOutput2014_v1; DMRLTOutput2014_v1*

Note: The metal finishing ELGs have limitations for cadmium, chromium, copper, lead, nickel, cyanide, total suspended solids, and oil and grease. These limitations may apply for E&EC facilities with metal finishing operations, noted with an asterisk in the table.

* An asterisk indicates that metal finishing ELGs may apply for E&EC facilities with metal finishing operations. The metal finishing ELGs have limitations for cadmium, chromium, copper, lead, nickel, cyanide, total suspended solids, and oil and grease.

[a] The subpart is listed for the pollutants that have limitations under the E&EC ELGs: A - Semiconductors; B - Electronic Crystals; C - CRT; D - Luminescent Materials. The 24 pollutants that do not have limitations under the E&EC ELGs may be controlled by the technology basis used to develop the established ELGs.

[b] Represents the total number of facilities under the E&EC NAICS and/or SIC codes listed in Table 5-11 with a pollutant load greater than zero in *TRILTOutput2014_v1* and/or *DMRLTOutput2014_v1*.

To further understand current E&EC wastewater characteristics, EPA conducted a literature review, attended industry conferences, and contacted several facilities (see Section 5.2.2.2 for EPA's methodology for selecting facilities to contact), trade associations, and NACWA members.

SIA has indicated that as the industry has evolved according to Moore's Law,[52] it has adapted new tools, chemicals, materials, and operations. Since the 1980s, the semiconductor industry has incorporated up to 49 additional chemical elements into semiconductor manufacturing operations (ERG, 2016a). EPA's research confirmed that new manufacturing processes, operation practices, and chemicals adopted by the E&EC industry that may result in discharges of some of the pollutants listed in Table 5-14. For instance, some semiconductor manufacturing facilities use copper metallization, which was introduced in the 1990s and is an alternative to aluminum interconnects (ERG, 2016a). Similarly, a presentation at the ASMC SEMI Conference discussed a semiconductor manufacturing facility, which uses copper metallization for their Through-Silicon Via (TSV) process (Gopalakrishman, et al., 2016). Therefore, semiconductor facilities, which have incorporated copper metallization into manufacturing processes since the 1983 E&EC ELGs, may discharge copper in their wastewater because of this operational change (see Table 5-14). In addition, SIA provided information on the abatement of fluorinated greenhouse gases (used in chamber cleaning) resulting in fluoride in semiconductor wastewaters via wet scrubbers (ERG, 2016a).

EPA's research also identified that the semiconductor industry has developed several new process chemistries for photolithography over the past 30 years. Photolithography patterns a wafer using the steps illustrated in Figure 5-4. For example, the industry uses new solvent systems, such as ethyl lactate and propylene glycol monomethyl ether acetate (PGMEA). Also, semiconductor manufacturing facilities commonly use aqueous developers for photoresists, which contain tetramethyl ammonium hydroxide (TMAH). CMP slurries, used to chemically and physically polish the wafer surface, typically contain low concentrations of engineered nanomaterials (for further information on EPA's review of engineered nanomaterials see Section 6.1) (ERG, 2016a).

In addition, some newer, chemically amplified photoresists and antireflective coatings can contain perfluoroalkyl substances (e.g., perfluorooctanesulfonic acid (PFOS)). A study on treatment of PFOS in semiconductor wastewater points out that PFOS is primarily used in photolithography because of its unique properties, including optical characteristics and acid-generating efficiency (Tang, et al., 2006). Specifically, during photolithography the semiconductor industry uses PFOS in photoresist (0.02 percent to 0.1 percent PFOS concentration), antireflective coating (0.1 percent PFOS concentration), and developer solutions (0.01 percent to 1.0 percent PFOS concentration). While most photolithography waste is handled as solvent and incinerated, Tang indicates that some facilities send approximately 40 percent of waste antireflective coating (containing PFOS) to wastewater treatment. Due to the unique chemical properties of PFOS, Tang indicates that it could take the semiconductor industry 10 years to 15 years to identify a PFOS substitute. Therefore, the semiconductor industry continues

[52] Moore's Law is the observation that the number of transistors per square inch on semiconductors has doubled approximately every two years since 1970 (see Section 5.2.2.2 for Moore's Law explanation).

to use PFOS for photolithography processes. The European Union proposed to ban the use of PFOS in 2006 (Tang, et al., 2006).

Despite rapid advances within the industry and changing operations and process chemistries, SIA indicated that semiconductor manufacturing requires specialized chemicals that operate precisely with advanced equipment and materials, and that offer distinctive functionality to accomplish high yield, high volume manufacturing. SIA asserted that chemical alternatives may not be available (or known) for use within the industry for certain operations. SIA indicated that researching chemical alternatives and incorporating them into a semiconductor manufacturing process might take 10 to 15 years.

Through facilities contacted as part of the current review (discussed in Section 5.2.2.2) EPA learned that some of the chemicals previously used in semiconductor manufacturing operations have been replaced. For instance, one facility noted that trichloroethylene had been phased out of operations 20 years ago (Wasielewski, 2016). Although some hazardous chemicals, PFOS for example, are difficult to replace in certain semiconductor manufacturing process steps. SIA stated that TTO have been eliminated from lithography and the industry has tried to eliminate or minimize other constituents of concern in specific process steps (e.g., organic solvents, ozone depleting substances, lead from assembly or packaging) (ERG, 2016a).

NACWA members stated that pollutants such as ammonia, nitrogen, sulfate, fluoride, and copper are becoming more prevalent in discharges from E&EC facilities. Additionally, due to water conservation programs, E&EC facilities are using less water; therefore, increasing the concentration of pollutants in the water discharged to POTWs (U.S. EPA, 2016c).

In summary, through various data sources described previously, EPA learned that E&EC wastewater characteristics have likely changed since 1983. Research indicates that the industry may be discharging several new pollutants not considered at the time of the 1983 rulemaking, and that are not reported to DMR or TRI, including some toxic pollutants (e.g., TMAH, PFOS) that are used in various semiconductor manufacturing processes. In addition, industry may be discharging more substantial quantities of certain previously considered and/or regulated pollutants including copper and fluoride due to manufacturing process changes. Additionally, as indicated by SIA, some facilities may have phased out the use of other pollutants regulated as part of the 1983 ELGs, such as TTO.

5.2.4 E&EC Wastewater Treatment Technologies

The E&EC ELGs established limitations for the E&EC Category generally based on solvent management to control TTO, neutralization, chemical precipitation with clarification (hydroxide), in-process control for specific pollutants, and filtration. See Section 5.2.1.3 for further details on the wastewater treatment technologies used to establish the E&EC ELGs.

To understand current wastewater treatment technologies and practices, EPA contacted several facilities and trade associations, conducted a literature review, and reviewed information available in EPA's Industrial Wastewater Treatment Technologies (IWTT) Database. For the facility contacts, EPA compiled a summary of the facility type, wastewater generation processes, and wastewater treatment technologies employed (see Section 5.2.2.2 for EPA's methodology for selecting facilities to contact). Most of the facilities contacted use the wastewater treatment technologies established in the E&EC ELGs; however, some facilities employ, or plan to employ, more advanced wastewater treatment. Biological treatment, ion exchange, electrowinning, and zeolite resin systems are examples of such advanced wastewater treatments. Table 5-13 provides a summary of the wastewater treatment information obtained from the facility contacts. While some of the facilities contacted are direct dischargers, SIA indicated that the vast majority of semiconductor manufacturing facilities pretreat semiconductor wastewater, through processes such as pH adjustment or neutralization, prior to discharging to a POTW, and use dedicated solvent waste drains and collection systems (ERG, 2016a). Some facilities will collect organic wastes for reuse (e.g., isopropyl alcohol, n-methyl pyrrolidone) (ERG, 2016a). SIA explained that some semiconductor manufacturing plants have implemented water reuse practices, such as using RO reject water in other process operations (e.g., scrubbers, cooling towers); however, no zero discharge semiconductor facilities exist in the U.S. to their knowledge (ERG, 2016a). Similarly, NACWA stated that they were not aware of any E&EC zero discharge facilities (U.S. EPA, 2016c).

EPA also performed a targeted literature search and identified several wastewater treatment studies specific to the E&EC industry. For instance, a bench-scale study (Tang, et al., 2006) investigated the removal of PFOS from semiconductor wastewater. As of 2006, PFOS was an essential photolithographic chemical with no chemical substitutes; however, PFOS is toxic, bioaccumulative, and persistent. Tang found PFOS at concentrations of about 1,650 mg/L in semiconductor wastewater generated from developing and wet stripping washes. In many cases, facilities neutralize and send this wastewater to a POTW. However, Tang's study found RO membranes typically removed 99 percent or more of the PFOS from the wastewater over a wide range of influent concentrations (0.5 to 1,500 mg/L). Since the majority of semiconductor facilities use RO membranes for the production of ultrapure water, Tang indicates that the semiconductor industry is familiar with this wastewater treatment technology and could potentially use RO treatment for wastewater containing PFOS.

As mentioned in Section 5.2.2.2, EPA identified another bench-scale study (Sturgill, et al., 2000) that evaluated a new method for recovering and recycling gallium and arsenic from GaAs polishing wastes. GaAs-based semiconductor devices are used in military and commercial applications (e.g., lasers, LEDs). In 2000, the technique for recovery was ferric hydroxide precipitation and filtration, with the resulting wastewater discharged to a POTW or to a surface water and wastes sent to landfills. The newer method, described by Sturgill, involves pH adjustment, centrifugation (sludge to recovery), filtration, ferric hydroxide coprecipitation, and settling with filtration (Sturgill, et al., 2000).

A patented wastewater treatment process, presented at the 2013 International Water Conference, treats wastewater generated by the microelectronics industry. Bench-scale and pilot-scale studies demonstrated the system could treat total organic carbon (TOC), TMAH, and total Kjeldahl nitrogen (TKN). Specifically, the system consists of three stages in series:

- Aerobic biological treatment – an activated sludge aerobically degrades organic nitrogen and organics into ammonia-nitrogen and carbon dioxide.
- Oxidation – an ozonation system chemical oxidizes ammonia into nitrates.

- Anaerobic biological treatment – an activated sludge anaerobically denitrifies the nitrates into nitrogen gas (Ballard, et al., 2013).

The study indicated this system achieved greater than 98 percent removal of TOC, 99 percent of TMAH, and 95 percent of TKN. As stated above, TMAH is a chemical used in photoresists for newer photolithography processes. TMAH is hazardous because it is toxic, corrosive, slow to biodegrade, and can contribute to eutrophication of water bodies. According to the study author, the patented aerobic/anaerobic biological treatment system with denitrification is a robust and low-cost alternative for wastewater generated at semiconductor and TFT-LCD manufacturing facilities (Ballard, et al., 2013; Infilco Degremont Inc., 2014).

One semiconductor manufacturing facility, Global Foundries East Fishkill Facility in Hopewell Junction, New York, provided specific details on a heavy metal wastewater treatment plant it employs on site (Marone, 2016). The heavy metal wastewater treatment plant consists of calcium hydroxide precipitation (to remove fluoride and other metals), microfiltration, polymer flocculation, an acid/base slurry treatment step, and clarification. In addition, the facility operates an ammonia treatment plant for segregated industrial wastewater streams, where ammonia is removed, distilled, and marketed to another party (Marone, 2016).

To identify additional emerging technologies that are being evaluated and/or implemented by the E&EC industry, EPA reviewed recent literature compiled in the IWTT Database (for more information on the IWTT Database, see Section 6.2 of this report). EPA queried the IWTT Database for treatment of E&EC wastewater, which produced five articles with pollutant removal data (Huang, et al., 2011; K. Kim, et al., 2012; S. Kim, et al., 2011; Mehta, et al., 2014; Ryu, et al., 2008). Table 5-15 presents the parameter effluent concentration and percent removal data for all five articles. All but one of the studies were pilot scale (Ryu, et al., 2008). However, EPA identified two studies that evaluated the performance of traditional chemical precipitation systems used by the industry, and three studies focused on more advanced technologies for the industry, including biological treatment or filtration technologies. In addition, most of the studies evaluated removal efficiency of pollutants that do not currently have E&EC ELGs, including ammonium-nitrogen, TOC, COD, and TMAH (Huang, et al., 2011; K. Kim, et al., 2012; S. Kim, et al., 2011; Mehta, et al., 2014; Ryu, et al., 2008).

Table 5-15. Summary of Wastewater Treatment Technologies for Electrical and Electronic Components Wastewater

Wastewater Treatment Technology (Order of Unit Processes)	Treatment Scale	Parameter	Effluent Concentration (mg/L)	Percent Removal	Reference
Anaerobic Suspended Growth, Aerobic Suspended Growth, Clarification, Advanced Oxidation Processes (NEC), Anaerobic Suspended Growth, and Clarification	Pilot	Ammonium-nitrogen (NH_4-N)	3	78.57%	(Mehta, et al., 2014)
		Chemical oxygen demand	NR	98.00%	
		Nitrogen, Kjeldahl total (TKN)	27	83.64%	
		Tetramethyl ammonium hydroxide (TMAH)	NR	80.00%	
		Total organic carbon (TOC)	NR	98.00%	
Aerobic Suspended Growth, Clarification, Advanced Oxidation Processes (NEC), Anaerobic Suspended Growth, and Clarification	Pilot	Ammonium-nitrogen (NH_4-N)	6.4	8.57%	
		Nitrogen, Kjeldahl total (TKN)	26	96.53%	
		Tetramethyl ammonium hydroxide (TMAH)	NR	99.00%	
		Total organic carbon (TOC)	NR	98.00%	
Electrocoagulation	Pilot	Copper	NR	95.00%	(K. Kim, et al., 2012)
Chemical Precipitation, Controlled Hydrodynamic Cavitation, and Clarification	Pilot	Calcium	23.4	90.71%	(S. Kim, et al., 2011)
Granular-Media Filtration, Membrane Filtration, and Reverse Osmosis	Pilot	Alkalinity (as $CaCO_3$)	< 1.5	> 97.69%	(Huang, et al., 2011)
		Ammonium-nitrogen (NH_4-N)	1.62	84.57%	
		Chemical oxygen demand	4.9	93.57%	
		Chloride	21.1	92.19%	
		Conductivity	69.2	97.35%	
		Hardness (as $CaCO_3$)	< 1.5	> 99.12%	
		Nitrate (as N)	0.73	51.33%	
			0.06	71.43%	
		Silicate (SiO_4-2 as SiO_2)	0.98	88.28%	
		Sulfate (as SO_4)	0.34	99.87%	
		Suspended solids	1	97.50%	
		Total dissolved solids (TDS)	53.5	95.18%	
		Total organic carbon (TOC)	1.3	76.79%	
		Turbidity	0.06	99.80%	
Chemical Precipitation and Clarification	Full	Ammonium-nitrogen (NH_4-N)	17	88.96%	(Ryu, et al., 2008)

NR – Not Reported

5.2.5 Summary of EPA's Continued Review of the E&EC Category

As part of the current review, EPA expanded the scope of its review beyond sapphire crystal manufacturing, considered in the 2015 Annual Review, to include the entire E&EC Category. Furthermore, EPA studied the E&EC industry to understand how the industry profile, wastewater discharges, and wastewater treatment have changed since promulgation of the ELGs in 1983. EPA analyzed all four subparts of the 1983 E&EC ELGs, with a specific emphasis on Subpart A, semiconductor manufacturing. EPA evaluated several publicly available data sources including DMR and TRI data, IBISWorld industry market reports, economic census data, and peer-reviewed journal articles (from the literature review and IWTT Database). In addition, EPA contacted facilities, met with SIA, and attended industry conferences (2016 ASMC SEMI conference, 2016 SEMICON West).

From these data collection efforts, EPA learned that the majority of E&EC facilities are indirect dischargers (discharge to POTWs). They have implemented several new process operations using new chemicals and the resulting wastewater characteristics have likely changed over time. Further, the industry may also be phasing out the use of some currently regulated pollutants, including TTO.

Specifically, relating to all four of the existing E&EC subcategories, from this review, EPA learned:

- *Subpart A – Semiconductor Manufacturing.*
  - Over the past 30 years, discharge practices have not changed dramatically. Most semiconductor manufacturing facilities continue to discharge to POTWs. SIA and NACWA members stated they were not aware of any zero discharge semiconductor manufacturing facilities (ERG, 2016a; U.S. EPA, 2016c).
  - EPA did not identify significant changes in the overall semiconductor manufacturing process operation sequence, though semiconductor manufacturers have added updated processes (e.g., plating, CVS, copper metallization, CMP, C4 bump) and increased repetition of the sequence (from up to 20 times in 1983 to 90 times in 2016).
  - EPA confirmed that updated manufacturing processes introduce new pollutants in the wastewater, due to new materials, lithography process chemistries, and advancement of tools required to keep up with rapidly changing technology demands. Most noteworthy of the new pollutants are PFOS and TMAH, which are toxic, persistent, and bioaccumulative (ERG, 2016a; Tang, et al., 2006). NACWA members also expressed concerns with higher concentrations of ammonia, nitrogen, sulfate, fluoride, and copper discharged from E&EC facilities (U.S. EPA, 2016c).
  - EPA's review of wastewater treatment technologies shows that the industry continues to rely on the traditional technologies identified at the time of the 1983 ELG rulemaking. However, the industry is actively evaluating new technologies (e.g., biological, ion exchange, reverse osmosis, electrowinning) and wastewater management practices (e.g., rinse recycle, RO reject recycle) aimed at treating some of the newer pollutants and conserving water.

- *Subpart B – Electronic Crystal Manufacturing.*
  - During the 2015 Annual Review, EPA concluded that sapphire crystal manufacturing is a growing sector of the electronic crystal manufacturing industry and that the E&EC ELGs apply to this sector. Though EPA did not specifically focus on electronic crystals manufacturing during this review, at least one source that suggests that GaAs and sapphire crystal manufacturing process steps are similar in nature, and that the manufacturing process operation sequence has not changed substantially since 1983.
  - EPA has not thoroughly investigated the processes, wastewater characteristics, discharges, or treatment associated with existing electronic crystal manufacturing.
- *Subpart C – CRT Manufacturing.*
  - EPA's research indicates that CRTs have mostly been replaced by newer technologies (e.g., LCD, OLED, plasma display) for TV applications. EPA confirmed that the market for electron tube manufacturing has decreased significantly since 1983. In addition, several regulations and other efforts have been established for recycling CRTs, suggesting their accelerated phase out.
  - While EPA has identified replacement technologies for CRTs, EPA has not evaluated current processes, wastewater generation, or treatment technologies.
- *Subpart D – Luminescent Materials Manufacturing.*
  - Luminescent materials consisted of fluorescent lamp phosphors in 1983 (applied, e.g., in TVs, video game displays, and lamps); however, most of these applications have been replaced with newer technologies, such as LEDs.
  - While EPA has identified replacement technologies for luminescent materials, EPA has not evaluated current processes, wastewater generation, or treatment technologies.

5.2.6 E&EC Category References

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33. Wasielewski, Ryan. (2016). Telephone Communication Between Ryan Wasielewski, Powerex Inc., and Anna Dimling, Eastern Research Group, Inc. Re: Powerex Inc. in Youngwood, PA. (April 4). EPA-HQ-OW-2015-0665. DCN 08358.

5.3 Miscellaneous Food and Beverage Sectors

EPA reviewed the miscellaneous food and beverage sectors because they have collectively ranked relatively high in EPA's past toxicity rankings analyses (TRAs). The most recent TRA was completed for the 2015 Annual Review. EPA, however, has not specifically evaluated individual food and beverage sectors and discharges in recent years because most of the toxic discharges have been from a single facility[53] (U.S. EPA, 2016). Table 5-16 lists the miscellaneous food and beverage sectors by Standard Industrial Classification (SIC) and North American Industry Classification System (NAICS) codes.

Table 5-16. Miscellaneous Food and Beverage Sectors

SIC Code	SIC Description	NAICS Code	NAICS Description
2038	Frozen Specialties, Not Elsewhere Classified	311412	Frozen Specialty Food Manufacturing
2045	Prepared Flour Mixes and Doughs	--	--
2051	Bread and Other Bakery Products, except Cookies and Crackers	--	--
2052	Cookies and Crackers	311821	Cookie and Cracker Manufacturing
2064	Candy and Other Confectionery Products	311352	Confectionery Manufacturing from Purchased Chocolate
2066	Chocolate and Cocoa Products	311351	Chocolate and Confectionery Manufacturing from Cacao Beans
2074	Cottonseed Oil Mills	--	--
2075	Soybean Oil Mills	311224	Soybean and Other Oilseed Processing
2079	Shortening, Table Oils, Margarine, and Other Edible Fats and Oils, Not Elsewhere Classified	311225	Fats and Oils Refining and Blending
2082	Malt Beverages	312120	Breweries
2084	Wines, Brandy, & Brandy Spirits	312130	Wineries
2085	Distilled and Blended Liquors	312140	Distilleries
2086	Bottled and Canned Soft Drinks and Carbonated Water	312111	Soft Drink Manufacturing
2087	Flavoring Extracts and Flavoring Syrups, Not Elsewhere Classified	311930	Flavoring Syrup and Concentrate Manufacturing
2097	Manufactured Ice	--	--
2098	Macaroni, Spaghetti, Vermicelli, and Noodles	--	--
2099	Food Preparations, Not Elsewhere Classified	311340	Nonchocolate Confectionery Manufacturing
		311942	Spice and Extract Manufacturing
		311991	Perishable Prepared Food Manufacturing
		311999	All Other Miscellaneous Food Manufacturing
--	--	311813	Frozen Cakes, Pies, and Other Pastries Manufacturing
--	--	311920	Coffee and Tea Manufacturing

Sources: (ERG, 2016); *DMRLTOutput2015_F&B_v1*; *TRILTOutput2015_F&B_v1*

[53] As part of the 2015 Annual Review, EPA identified one facility, Bacardi Corporation in Catano, Puerto Rico, that accounted for over 90 percent of the 2013 discharge monitoring report (DMR) toxic-weighted pound equivalent (TWPE) from the miscellaneous food and beverage sectors. EPA confirmed that the discharges met permit limits and resulted from molasses process wastewater used to manufacture rum (U.S. EPA, 2016).

EPA reviewed discharges from the sectors listed in Table 5-16 to identify any discharges that may require further review for potential development of effluent limitations guidelines and standards (ELGs) by conducting the following analyses:

- Reviewed SIC and NAICS codes for facilities reporting information to the Integrated Compliance Information System for the National Pollutant Discharge Elimination System (ICIS-NPDES) and Toxic Release Inventory (TRI), respectively, to ensure that the universe of facilities included in the analysis was representative of all food and beverage processing sectors not currently regulated by ELGs.
- Evaluated total estimated pounds of pollutants, facility counts, and pollutant discharge information in 2015 for miscellaneous food and beverage sectors using discharge monitoring report (DMR) and TRI data.
- For a subset of industry sectors, contacted state and EPA regional NPDES permitting authorities to better understand industry production and treatment characteristics.

Section 5.3.1 provides background on EPA's previous reviews of the miscellaneous food and beverage sectors. Section 5.3.2 summarizes EPA's current review of available pollutant discharge data for the miscellaneous food and beverage sectors. Section 5.3.3 summarizes EPA's further investigation of the distillery and soft drink manufacturing sectors. Section 5.3.4 summarizes this review.

5.3.1 Previous Review of the Miscellaneous Food and Beverage Sectors

EPA first reviewed miscellaneous food and beverage processing sectors in 1975, and, identified the primary pollutants discharged were conventional pollutants (biochemical oxygen demand (BOD), total suspended solids (TSS), oil and grease, and pH), rather than toxic pollutants (U.S. EPA, 1975a, 1975b). EPA considered establishing ELGs for conventional pollutants from direct discharging facilities in certain sectors, including vegetable oil processing and refining, beverages, bakery and confectionery products, pet foods, and miscellaneous and specialty products. EPA did not consider pretreatment standards for indirect dischargers because it concluded that none of the conventional pollutant constituents would interfere with or pass through publicly owned treatment works (POTWs). EPA, however, did not pursue ELGs for these sectors because it changed the focus of the ELGs program to the control of toxic pollutants shortly after completion of its review (U.S. EPA, 2006).

As part of its 2006 Annual Review, EPA performed a preliminary investigation of facilities in SIC codes 2075 – Soybean Oil Mills, 2083 – Malt Beverages, and 2085 – Distilled and Blended Liquors, to evaluate whether ELGs were warranted for addressing wastewater discharges. Consistent with the 1975 review, discharges from facilities within these sectors mostly discharge conventional pollutants rather than toxic pollutants. Additionally, facilities in these sectors employed onsite biological wastewater treatment or sent wastewater to POTWs to remove conventional pollutants. EPA thus decided not to establish ELGs for these sectors (Bicknell, 2004; U.S. EPA, 2006).

5.3.2 Review of Discharge Estimates for the Miscellaneous Food and Beverage Sectors

EPA evaluated the total pounds of pollutants discharged per year as reported in 2015 DMR and TRI data by SIC and NAICS code, as shown in Table 5-17. EPA used 2015 data for its review of the miscellaneous food and beverage sectors because they represented the most recent and complete set of industrial wastewater discharge data available at the time the review began. Specifically, EPA downloaded the 2015 TRI and DMR data from the Water Pollutant Loading Tool and followed the general quality review steps outlined in Section 2.1.2 to assess their completeness, accuracy, and reasonableness. From the quality review, EPA determined that the 2015 DMR and TRI data were useable for this review. EPA incorporated the DMR and TRI data into a set of static databases, *DMRLTOutput2015_F&B_v1* and *TRILTOutput2015_F&B_v1*, designed to preserve the integrity of the data and to support subsequent analyses integral to this review. EPA describes these databases below:

- *DMRLTOutput2015_F&B_v1* (DCN 08523): 2015 pollutant loadings (pounds per year) for industrial facilities, calculated based on DMR data.
- *TRILTOutput2015_F&B_v1* (DCN 08524): 2015 direct and indirect water releases (pounds per year) for industrial facilities.

Although DMR and TRI data are the most comprehensive and readily available source of industrial wastewater discharge data, the data pertain to a subset of actual pollutant discharges. The pollutants and quantities actually discharged are unknown. For instance, DMRs only include data for pollutants with discharge limits or monitoring requirements specified in NPDES permits. Facilities are only required to report pollutant releases to TRI if the releases meet or exceed certain reporting thresholds, and they are only required to report pollutants that are on the TRI Chemicals list. The TRI Chemicals list does not include conventional pollutants such as BOD and TSS. See Section 2.1 of this report for a detailed discussion of the uses and limitations of DMR and TRI data.

Table 5-17. DMR and TRI Discharge Estimates for the Miscellaneous Food and Beverage Sectors

SIC Code	SIC Description	NAICS Code	NAICS Description	DMR Data: 2015 Total Pounds per Year	DMR Data: Number of Facilities Reporting Pollutant Discharges[a]	DMR Data: Top Pollutants[b]	TRI Data: 2015 Total Pounds per Year	TRI Data: Number of Facilities Reporting Pollutant Discharges[a]	TRI Data: Top Pollutants[b]
2038	Frozen Specialties, Not Elsewhere Classified	311412	Frozen Specialty Food Manufacturing	102,000,000	5	TSS	58,500	12	Nitric acid, Ammonia, Nitrate
2085	Distilled and Blended Liquors	312140	Distilleries	50,300,000	32	COD, BOD, TSS, Zinc	4,530	2	Ammonia
2051	Bread and Other Bakery Products, except Cookies and Crackers	--	--	25,200,000	3	TDS	--	--	--
2086	Bottled and Canned Soft Drinks and Carbonated Water	312111	Soft Drink Manufacturing	16,800,000	16	BOD, TSS	23,900	5	Nitrate
2099	Food Preparations, Not Elsewhere Classified	311999	All Other Miscellaneous Food Manufacturing	8,470,000	16	BOD, TDS, TSS, Potassium, Ammonia, Nitrogen	732,000	30	Nitrate, Ammonia, Methanol
		311942	Spice and Extract Manufacturing				108,000	9	Methanol, Ethylene glycol
		311340	Nonchocolate Confectionery Manufacturing				13,400	3	Nitrate, Nitric acid
		311991	Perishable Prepared Food Manufacturing				2,850	1	Nitrate
2082	Malt Beverages	312120	Breweries	6,270,000	10	TSS, BOD, Phosphorus, Ammonia	2,140,000	18	Nitrate
2075	Soybean Oil Mills	311224	Soybean and Other Oilseed Processing	2,970,000	19	COD, BOD, TSS, Oil & Grease	1,550,000	55	Nitrate
2064	Candy and Other Confectionery Products	311352	Confectionery Manufacturing from Purchased Chocolate	450,000	1	COD, BOD	10,500	2	Nitrate
2079	Shortening, Table Oils, Margarine, and Other Edible Fats and Oils, Not Elsewhere Classified	311225	Fats and Oils Refining and Blending	173,000	7	TSS, BOD, Oil & Grease	13,000	3	Methanol

Table 5-17. DMR and TRI Discharge Estimates for the Miscellaneous Food and Beverage Sectors

SIC Code	SIC Description	NAICS Code	NAICS Description	DMR Data: 2015 Total Pounds per Year	DMR Data: Number of Facilities Reporting Pollutant Discharges[a]	DMR Data: Top Pollutants[b]	TRI Data: 2015 Total Pounds per Year	TRI Data: Number of Facilities Reporting Pollutant Discharges[a]	TRI Data: Top Pollutants[b]
2052	Cookies and Crackers	311821	Cookie and Cracker Manufacturing	111,000	4	TSS, Oil & Grease	967	1	Ammonia
2084	Wines, Brandy, & Brandy Spirits	312130	Wineries	98,200	8	Sodium, TSS, Total Oxygen Demand, BOD	183,000	2	Ammonia
2087	Flavoring Extracts and Flavoring Syrups, Not Elsewhere Classified	311930	Flavoring Syrup and Concentrate Manufacturing	14,800	2	TSS, COD	10,600	5	Ammonia, Nitrate, Methanol
2066	Chocolate and Cocoa Products	311351	Chocolate and Confectionery Manufacturing from Cacao Beans	5,670	1	TSS, BOD, Oil & Grease	2,720	1	Ammonia
2098	Macaroni, Spaghetti, Vermicelli, and Noodles	--	--	2,890	1	TDS	--	--	--
2074	Cottonseed Oil Mills	--	--	2,420	1	BOD, TSS	--	--	--
2097	Manufactured Ice	--	--	239	2	TSS	--	--	--
2045	Prepared Flour Mixes and Doughs	--	--	105	1	TSS, BOD	--	--	--
--	--	311920	Coffee and Tea Manufacturing	--	--	--	9,760	2	Nitrate
--	--	311813	Frozen Cakes, Pies, and Other Pastries Manufacturing	--	--	--	12.6	2	Ethylene glycol, Nitrate
Sum for all Miscellaneous Food and Beverage Sectors				**213,000,000**	**129**	**--**	**4,870,000**	**153**	**--**

Source: (ERG, 2016); *DMRLTOutput2015_F&B_v1*; *TRILTOutput2015_F&B_v1*

TSS: total suspended solids; COD: chemical oxygen demand; BOD: biochemical oxygen demand; TDS: total dissolved solids

[a] Number of facilities with pounds per year greater than zero.

[b] Top pollutants are the pollutants that collectively account for 95 percent or more of the total pollutant loads from facilities in each NAICS or SIC code.

5.3.3 Further Investigation of the Distillery and Soft Drink Manufacturing Sectors

Based on review of the DMR data summarized in Table 5-17, EPA selected Distilled and Blended Liquors (distilleries) (SIC Code 2085, NAICS Code 312140) and Bottled and Canned Soft Drinks and Carbonated Water (soft drink manufacturers) (SIC Code 2086, NAICS Code 312111) for further investigation because they ranked high relative to other sectors in terms of discharge amounts and number of facilities. EPA primarily relied on the DMR data in prioritizing the sectors for further investigation because the data are more comprehensive with respect to conventional pollutants, which have historically been associated with wastewater from food and beverage manufacturing sectors. See Section 2.1 of this report for a detailed discussion of the uses and limitations of TRI data.

5.3.3.1 Facility Counts for Distilleries and Soft Drink Manufacturers

To better understand the number and distribution of distilleries and soft drink manufacturers across the U.S., EPA also reviewed 2012 U.S. Census data to identify the number of facilities by state (U.S. Census, 2012). The U.S. Census provides the most complete available estimates of the number of industrial facilities in the U.S. As shown in Table 5-18, there are 458 soft drink manufacturers according to the U.S. Census, but only 16 facilities with DMR data and 5 facilities with TRI data. The discrepancy in facility counts is primarily due to DMR and TRI reporting requirements. For example, facilities are not required to submit DMR data for indirect discharges, so sectors with high numbers of facilities in the U.S. Census data may indicate facilities discharging indirectly to POTWs.

Table 5-18. States with Distilleries and Soft Drink Manufacturers

State	Distilleries			Soft Drink Manufacturers		
	Number of Establishments in Census Data (2012)	DMR Facilities (2015)	TRI Facilities (2015)	Number of Establishments in Census Data (2012)	DMR Facilities (2015)	TRI Facilities (2015)
Alabama	1	0	0	5	1	0
Alaska	2	0	0	1	0	0
Arizona	0	0	0	8	0	0
Arkansas	3	0	0	3	1	0
California	21	0	0	67	0	0
Colorado	18	0	0	7	0	0
Connecticut	2	0	0	9	0	0
Florida	8	1	0	27	0	1
Georgia	1	0	0	15	0	1
Hawaii	4	0	0	7	0	0
Idaho	3	0	0	3	0	0
Illinois	7	1	1	12	1	0
Indiana	2	2	0	8	1	1
Iowa	5	0	0	4	1	0
Kansas	2	5[a]	0	3	0	0
Kentucky	19	17	0	6	6	0
Louisiana	4	0	0	3	0	0
Maine	4	0	0	0	0	0
Maryland	3	0	0	8	0	0
Massachusetts	5	0	0	8	1	1

Table 5-18. States with Distilleries and Soft Drink Manufacturers

State	Distilleries			Soft Drink Manufacturers		
	Number of Establishments in Census Data (2012)	DMR Facilities (2015)	TRI Facilities (2015)	Number of Establishments in Census Data (2012)	DMR Facilities (2015)	TRI Facilities (2015)
Michigan	5	0	0	11	1	0
Minnesota	3	0	0	9	0	0
Mississippi	0	0	0	2	0	0
Missouri	4	1	1	9	0	0
Montana	6	0	0	4	0	0
Nebraska	0	1[a]	0	3	1	0
Nevada	2	0	0	3	0	0
New Hampshire	0	0	0	1	0	0
New Jersey	3	0	0	18	0	0
New Mexico	2	0	0	2	0	0
New York	13	0	0	31	0	0
North Carolina	6	0	0	14	0	0
North Dakota	0	0	0	1	0	0
Ohio	8	0	0	15	1	0
Oklahoma	0	0	0	7	0	0
Oregon	17	0	0	5	0	0
Pennsylvania	5	0	0	20	0	0
Rhode Island	1	0	0	3	0	0
South Carolina	2	0	0	4	0	0
South Dakota	0	0	0	1	0	0
Tennessee	6	2	0	13	1	0
Texas	17	0	0	36	0	1
Utah	2	0	0	6	0	0
Vermont	3	0	0	0	0	0
Virginia	4	0	0	10	0	0
Washington	17	0	0	11	0	0
West Virginia	3	0	0	1	0	0
Wisconsin	6	0	0	12	0	0
Wyoming	2	0	0	2	0	0
Virgin Islands[b]	-	1	0	-	0	0
Puerto Rico[b]	-	1	0	-	0	0
Total	**251**	**32**	**2**	**458**	**16**	**5**

Sources: (U.S. Census, 2012); DMRLTOutput2015_F&B_v1; TRILTOutput2015_F&B_v1
[a] U.S. Census data and DMR and TRI data are for different years (2012 and 2015, respectively).
[b] Industry data are not available for the Virgin Islands or Puerto Rico in the 2012 U.S. Census.

5.3.3.2 Top Pollutants Discharged by Distilleries and Soft Drink Manufacturers

EPA evaluated the facilities and pollutants contributing to the majority of the total pollutant loads in the distillery and soft drink manufacturing sectors as shown in Table 5-19 and Table 5-20. For this review, EPA defined the top pollutants as those that collectively account for 95 percent or more of the total pollutant discharges from facilities in a sector. Among distilleries, the top DMR pollutants were chemical oxygen demand (COD), BOD, TSS, zinc, chloride, oil and grease, and phosphorus. Ammonia accounted for 99 percent of discharges reported to TRI by distilleries. The data demonstrate that, with the exception of BOD, the top pollutants reported to DMR and TRI from distilleries are discharged by one, or possibly two, facilities.

The top DMR pollutants discharged by soft drink manufacturers included BOD, TSS, total filterable residue, and chloride. Nitrate compounds were the top TRI pollutant discharged by soft drink manufacturing facilities. The data demonstrates that the top pollutants as reported to DMR and TRI from soft drink manufacturing facilities are discharged from one or two facilities.

Table 5-19. Pollutants Estimated to be Discharged in the Highest Amounts in 2015 by the Distillery Sector

Pollutant	Total Pounds	Facilities Reporting Discharge	Facility Location	Facility Percent of Total Sector Pounds
2015 DMR Data				
COD	38,000,000	Virgin Islands Rum Industries	Frederiksted, VI	99.9%
BOD	5,050,000	Bacardi Corp	San Juan, PR	94.5%
		Illinois Corn Processing LLC	Pekin, IL	1.80%
		Campari America	Lawrenceburg, KY	1.19%
		MGP Ingredients Inc.	Atchison, KS	1.17%
		Jim Bean Brands Co.[a]	Frankfort, KY	0.95%
TSS	3,440,000	Virgin Islands Rum Industries	Frederiksted, VI	61.8%
		Woodford Reserve Distillery[a]	Versailles, KY	19.0%
Zinc	1,320,000	Woodford Reserve Distillery[a]	Versailles, KY	99.9%
Chloride	761,000	MGP Ingredients Inc	Atchison, KS	73.2%
Oil and Grease	727,000	Woodford Reserve Distillery[a]	Versailles, KY	89.9%
Phosphorus	469,000	MGP Ingredients Inc.	Atchison, KS	97.9%
2015 TRI Data				
Ammonia	4,500	Illinois Corn Processing LLC	Pekin, IL	99.4%

Source: (ERG, 2016); *DMRLTOutput2015_F&B_v1; TRILTOutput2015_F&B_v1*
TSS: total suspended solids; COD: chemical oxygen demand; BOD: biochemical oxygen demand
[a] Facility identified as having potential data errors, described in Table 5-21.

Table 5-20. Pollutants Estimated to be Discharged in the Highest Amounts in 2015 by the Soft Drink Manufacturing Sector

Pollutant	Total Pounds	Facilities Reporting Discharge	Facility Location	Facility Percent of Total Sector Pounds
2015 DMR Data				
BOD	15,200,000	Wis Pak of Norfolk Incorporated	Norfolk, NE	99.9%
TSS	1,500,000	Wis Pak of Norfolk Incorporated	Norfolk, NE	79.9%
		Pepsi Cola Bottling Co.	Corbin, KY	18.8%
Total Filterable Residue (dried at 105°C)	63,000	G&J Pepsi Cola Bottling Co.	Franklin Furnace, OH	100%
Chloride	44,600	Pepsi Cola Bottling Co.	Austin, IN	56.1%
		Nestle Water North America, Inc.	Red Boiling Springs, TN	43.9%

Table 5-20. Pollutants Estimated to be Discharged in the Highest Amounts in 2015 by the Soft Drink Manufacturing Sector

Pollutant	Total Pounds	Facilities Reporting Discharge	Facility Location	Facility Percent of Total Sector Pounds
2015 TRI Data				
Nitrate Compounds	22,700	Coca-Cola Refreshments	Northampton, MA	60.7%
		Coca-Cola North America – Waco Plant	Waco, TX	34.8%

Source: (ERG, 2016); *DMRLTOutput2015_F&B_v1; TRILTOutput2015_F&B_v1*
TSS: total suspended solids; BOD: biochemical oxygen demand

5.3.3.3 Review of the Accuracy of DMR Data for the Distillery and Soft Drink Manufacturing Sectors

EPA reviewed the accuracy of the DMR data for distillery and soft drink manufacturing facilities responsible for the high loads of the top pollutants in their sectors. EPA examined facility discharge flows and pollutant concentrations to evaluate if they were similar from month to month, because unusually high or low values may indicate potential reporting errors. EPA identified five facilities with potential data errors, as shown in Table 5-21. EPA then discussed the accuracy of the data with NPDES permitting authorities, as discussed below in Section 5.3.3.4.

Table 5-21. Facilities with Potential Data Errors

Facility Name & Location (NPDES ID)	Review Results
Distilleries	
Campari America, Lawrenceburg, KY (KY0001643)	EPA identified potential unit errors for BOD quantities from outfall 002; January, February, March, and October 2015 BOD quantities were two orders of magnitude (10^2 x) larger than other months.
Jim Beam Brands Co., Frankfort, KY (KY0001252)	EPA identified a potential unit error for a flow value from outfall 002; the December 2015 flow value was three orders of magnitude (10^3 x) larger than other months.
Woodford Reserve Distillery, Versailles, KY (KY0102261)	EPA identified potential unit errors for flow values from outfall 001; July and August 2015 flow values were six orders of magnitude (10^6 x) higher than other months.
Soft Drink Manufacturers	
Pepsi Cola Bottling Co., Corbin, KY (KYR003303)	EPA identified potential unit errors for flow values from outfall 001, 002, 003, and 004; December 2015 flow values were two orders of magnitude (10^2 x) higher than other months.
Wis Pak, Norfolk, NE (NE0131059)	EPA identified potential unit errors for flow values from outfall 001; March and June 2015 flow values were two orders of magnitude (10^2 x) larger than other months.

Source: *DMRLTOutput2015_v1*

5.3.3.4 Follow Up with NPDES Permitting Authorities

To gather more information on the operations and discharges from facilities in Table 5-21, EPA contacted EPA Region 2, the California State Water Resources Control Board, Illinois EPA, the Kansas Department of Health and Environment, the Kentucky Energy and Environment Cabinet, the Nebraska Department of Environmental Protection, and the Ohio EPA. EPA obtained copies of facility permits and gathered information on process operations, wastewater characteristics, and current wastewater treatment practices for the distillery and soft drink manufacturing sectors.

Follow-up with NPDES Permitting Authorities Concerning Distilleries

EPA Region 2 confirmed that the DMR data were accurate for the two distilleries in the Virgin Islands and Puerto Rico. EPA also contacted state NPDES permitting authorities concerning the six distilleries in Illinois, Kansas, and Kentucky identified in Table 5-19, and confirmed that the DMR data were accurate. State NPDES permitting authorities stated that relatively high discharges of BOD, TSS, and oil and grease at four of the distilleries, and zinc at one of the distilleries, result from non-process wastewater, including non-contact stormwater or commingled sanitary wastewater. At three other distilleries, NPDES permitting authorities confirmed that process wastewater contributes to the relatively high BOD, COD, TSS, chloride, and phosphorus discharges identified by this review.

As shown in Table 5-19, zinc is the only top pollutant reported by distilleries in 2015 that is a toxic pollutant. EPA confirmed that zinc is only discharged by one facility in Kentucky and originates from stormwater rather than process wastewater. NPDES permitting authorities did not identify additional pollutants discharged from distilleries that are of concern. Information provided by NPDES permitting authorities is summarized in Table 5-22.

NPDES permitting authorities also told EPA how two distilleries are working to reduce their discharges. MGP Ingredients, Inc. in Kansas is conducting a pilot treatment study in accordance with the state's nutrient reduction policy. The Cruzan Rum Distillery in the Virgin Islands recently installed a new Condensed Molasses Soluble evaporative process plant that will significantly reduce BOD, COD, and TSS discharges.

EPA also contacted the California State Water Resources Control Board to identify why none of the 21 distilleries in California, as shown in Table 5-18, reported DMR or TRI data for 2015. EPA identified that distilleries in California indirectly discharge their process wastewater to POTWs. As noted above in Section 5.3.3, facilities are not required to report discharges of conventional pollutants to TRI, nor are they required to report DMR data concerning indirect discharges.

Table 5-22. Summary of Follow-up with NPDES Permitting Authorities Concerning Distilleries

State	Facility Name and Location (NPDES ID)	Top Pollutants Discharged by Facilities	Primary Source of Pollutant at Outfall[a]	Description of Information Gathered from State/Region	Reference(s)
California	No specific facilities identified	NA	NA	State contact confirmed that all distilleries in California discharge to POTWs.	(Vazquez, 2017)
Kentucky	Jim Beam Brands, Frankfort, KY (KY0001252)	BOD	Stormwater	Facility does not directly discharge process wastewater. High BOD loadings at outfall due to stormwater.	(KY DEP, 2013a)
	United Distillers, Owensboro, KY (KY0001031)	TSS	Stormwater	Facility does not directly discharge process wastewater. High TSS loadings at outfall due to stormwater.	(KY DEP, 2016a)
	Campari America, Lawrenceburg, KY (KY0001643)	BOD	Sanitary effluent	The facility discharges process wastewater combined with sanitary wastewater through one outfall. The facility's permit presents concentration-based BOD limits but notes that they only need to be applied when the sanitary wastewater makes up 100 percent of the discharge.	(KY DEP, 2015)
	Woodford Reserve Distillery, Versailles, KY (KY0102261)	Oil & grease, zinc, TSS	Stormwater	Facility does not directly discharge process wastewater. State contact stated that high oil & grease, zinc, and TSS discharges are due to stormwater runoff. Zinc is a common pollutant in Kentucky's industrial stormwater. Exact source of zinc in facility's runoff is unknown, but may have been due to roofing materials.	(Becker, 2017; KY DEP, 2016b)
Kansas	MGP Ingredients Inc., Atchison, KS (KS0100269)	BOD, chloride, phosphorus	Wheat starch and gluten process wastewater; ferric chloride; phosphoric acid	Facility combines ethanol process wastewater with wheat starch and gluten process wastewater. The wastewater is sent to a conditioning tank, anaerobic digester, aeration basin, and clarifier prior to discharge. To allow for effective treatment, the facility adds ammonia nitrogen and phosphoric acid to the wastewater in the conditioning tank and ferric chloride and micro-nutrients (copper, cobalt, nickel, aluminum) to the anaerobic digester. Even with added nutrients, the wheat component of the process wastewater is not readily amenable to biological reduction, so the effluent BOD concentration remains high. According to the state contact, the facility is working with permitting authorities to conduct a pilot study on nutrient reduction practices specifically for phosphorus, in accordance with the state nutrient reduction policy. The study is not specifically targeting BOD removal.	(Carlson, 2017; KS DHE, 2011)

Table 5-22. Summary of Follow-up with NPDES Permitting Authorities Concerning Distilleries

State	Facility Name and Location (NPDES ID)	Top Pollutants Discharged by Facilities	Primary Source of Pollutant at Outfall[a]	Description of Information Gathered from State/Region	Reference(s)
Illinois	Illinois Corn Processing LLC, Pekin, IL (IL0002909)	BOD, TSS	Process wastewater	Facility makes both beverage- and fuel-grade ethanol. The BOD and TSS quantities did not exceed permit limits. The IL EPA is in the process of reissuing a new permit for this facility and is providing a copy to EPA.	(LeCrone, 2017)
Region 2	Virgin Islands Rum Industries, Cruzan Rum Distillery, Frederiksted, VI (VI0020052)	COD, TSS	Process wastewater	Facility previously discharged fermenter bottoms, seed-tank cleanings, fermenter-tank cleanings, and floor washings via Outfall 001. However, the facility completed construction of a condensed molasses solubles plant to reduce COD, BOD, and TSS loadings through an evaporative separation process. The EPA Region 2 permitting authority indicated that two other distilleries in the Virgin Islands operate as zero discharge facilities, including Diageo in Christiansted.	(Latner, 2017; U.S. V.I. DPNR, 2016)
	Bacardi Corp., San Juan, PR (PR0000591)	BOD	Adjacent wastewater treatment plant effluent	The permitted discharge from the facility is commingled with permitted discharges from two adjacent POTWs and discharged to the ocean via a single outfall. The POTWs have separate NPDES permits and were granted a modification that allows higher permit limits than secondary treatment requirements under Section 301(h) of the Clean Water Act. Permit limits for BOD and TSS for the POTWs and the facility are based on water quality criteria and remain high due to the large mixing zones at the joint ocean outfall.	(Latner, 2017)

NA: Not applicable.
TSS: total suspended solids; COD: chemical oxygen demand; BOD: biochemical oxygen demand
[a] EPA identified the primary source of the pollutant at the outfall from the state/region contact or the facility permit and fact sheet.

Follow-up with NPDES Permitting Authorities Concerning Soft Drink Manufacturers

EPA contacted NPDES permitting authorities concerning three facilities in Kentucky, Nebraska, and Ohio, identified in Table 5-20. One of the three facilities discharges only non-process wastewater such as non-contact stormwater. A second facility has an NPDES permit, but discharges process wastewater to a POTW. The only water that the third facility discharges directly to surface waters is reverse osmosis reject water; it discharges all its process wastewater to a POTW. The reject water is produced when source water is treated before its use in manufacturing. Information provided by NPDES permitting authorities is summarized in Table 5-23. As with distilleries, California confirmed that soft drink manufacturers in the state indirectly discharge their process wastewater to POTWs.

Table 5-23. Summary of Follow-up with NPDES Permitting Authorities Concerning Soft Drink Manufacturers

State	Facility Name and Location (NPDES ID)	Top Pollutants Discharged by Facilities	Primary Source of Pollutant at Outfall[a]	Description of Information Gathered from State/Region	Reference(s)
California	No specific facilities identified	NA	NA	State contact confirmed no NPDES-permitted soft drink manufacturers exist in California. Soft drink manufacturers in the state discharge to POTWs.	(Vazquez, 2017)
Kentucky	Pepsi Cola Bottling Co., Corbin, KY (KYR003303)	TSS	Stormwater	Permit revealed that four outfalls with high TSS discharges in 2015 discharged stormwater only. State contact noted that the facility is covered under Kentucky's Industrial Stormwater General Permit for Other Facilities.	(KY DEP, 2013b)
Ohio	G&J Pepsi Cola Bottling Co., Franklin Furnace, OH (OH0135267)	Total filterable residue	Reverse osmosis reject water	The facility directly discharges reverse osmosis reject water to surface water at Outfall 001 where they report high discharges of total filterable residue. The state contact confirmed that the facility is required to report total filterable residue, not TDS. All other process wastewater is discharged indirectly to a POTW through a separate outfall.	(Nygaard, 2017)
Nebraska	Wis Pak, Norfolk, NE (NE0131059)	BOD, TSS	Indirect discharge[b]	NE DEQ confirmed that although the facility has a NPDES permit, they discharge process wastewater through Outfall 001 (which had high BOD and TSS loadings in 2015) indirectly to a POTW. EPA recommends that the discharge data for Outfall 001 be excluded from the soft drink manufacturers review.	(Anderson, 2017; NE DEQ, 2015)

NA: Not applicable.

TSS: total suspended solids; BOD: biochemical oxygen demand

[a] EPA identified the primary source of the pollutant at the outfall from the state/region contact or the facility permit and fact sheet.

[b] The facility reported BOD and TSS loadings at an outfall on their 2015 DMR, but the state contact confirmed that the process wastewater through this outfall is indirectly discharged.

5.3.4 Summary of EPA's Review of Miscellaneous Food and Beverage Sectors

Through this review, EPA learned:

- Over 92 percent of distilleries and soft drink manufacturers (654 of 709, as shown in Table 5-18) in the study period did not report discharges to DMR or TRI.
- Conventional pollutants such as BOD, TSS, and oil and grease continue to be the top pollutants discharged directly to process wastewaters from distilleries and soft drink manufacturers.
- Based on a review of selected facilities, non-process wastewaters, such as sanitary effluent and stormwater, often are the sources of pollutant discharges reported on DMRs.
- Many of the top pollutants discharged by distilleries and soft drink manufacturers are conventional pollutants, therefore, EPA did not follow up on reported indirect discharges (which go to POTWs) because POTWs are designed to treat conventional pollutants.

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6. EPA'S CONTINUED INVESTIGATIONS OF POLLUTANTS AND TREATMENT TECHNOLOGIES

EPA continued several ongoing investigations identified in the *Final 2014 Effluent Guidelines Program Plan* (EPA-HQ-OW-2014-0170-0210) and is presenting its current evaluations as part of this review. Specifically, EPA continued its (1) investigation of the manufacture and processing of engineered nanomaterials (ENMs) as a potential new source of industrial wastewater discharge; (2) review of relevant literature documenting the performance of new and improved industrial wastewater treatment technologies for inclusion in its Industrial Wastewater Treatment Technology (IWTT) Database, to be used in future annual reviews; and (3) targeted review of pesticide active ingredient (PAI) discharges from pesticide manufacturing that are not currently regulated under the Pesticide Chemicals ELGs.

EPA documented the quality of the data supporting its review of these industrial categories, analyzed how the data could be used to characterize the industrial wastewater discharges, and prioritized the evaluations for further review. See Appendix A of this report for more information on data usability and the quality of the data sources supporting these reviews.

Sections 6.1, 6.2, and 6.3 of this report provide details of EPA's continued investigations into ENMs, industrial wastewater treatment technologies, and pesticide chemicals, respectively.

6.1 Continued Review of Engineered Nanomaterials (ENMs) in Industrial Wastewater

Nanomaterials are generally defined as engineered or naturally occurring materials composed of primary particles, with sizes on the order of 1 to 100 nanometers (nm) in at least one dimension, that show physical, chemical, and biological properties not found in bulk samples of the same material (U.S. EPA, 2011). These primary particles, termed nanoparticles, may exhibit novel, size-dependent characteristics, such as increased strength, chemical reactivity, and conductivity, due to their high surface area-to-volume ratio (Gavankar, et al., 2012). Engineered nanomaterials (ENMs) are designed to serve a particular purpose and, as opposed to naturally occurring nanoscale materials, represent a new or additional input to the environment.

In its *Final 2010 Effluent Guidelines Program Plan,* EPA solicited data and information for future annual reviews on the manufacture, use, and environmental release of silver nanomaterials, due to their anti-microbial activity and potential to create a source of silver in associated industrial wastewater discharges (U.S. EPA, 2011). Several commenters indicated that EPA should investigate the impact of nanosilver; a few indicated that EPA should investigate all nanomaterials (U.S. EPA, 2013). In response, EPA began evaluating ENMs as a potential emerging industrial wastewater pollutant category as part of its 2014 Annual Review (U.S. EPA, 2015a).

In the 2014 Annual Review, EPA focused its evaluation of the potential presence and impact of ENMs in industrial wastewater on three classes of ENMs: silver, titanium dioxide, and carbon-based nanomaterials. At the time, these compounds were widely produced and more fully characterized than other types of ENMs. From its review, EPA learned that ENM manufacturing and processing spans multiple industrial sectors (e.g., organic chemicals, plastics, and synthetic fibers (OCPSF) manufacturing, metal finishing, textiles, biomedical applications, and other consumer products), but identified little progress to date to quantify production volumes. Some

ENM manufacturing and processing methods likely generate wastewater, but the quantity generated and waste management practices are not documented. In addition, research has shown that common treatment technologies employed at municipal wastewater treatment plants can remove nanomaterials from the wastewater, but that these may then accumulate in the sludge. Further, EPA has not approved any standardized methods for sampling, detecting, or quantifying nanomaterials in aqueous media, though methods for detecting and characterizing nanomaterials in complex media, like industrial wastewater, are under development. EPA concluded that ENMs present a challenge for environmental monitoring, risk assessment, and regulation due to their small size, unique properties, and complexity (U.S. EPA, 2015a). Specifically, in the *Final 2014 Effluent Guidelines Program Plan,* EPA identified several areas for further research necessary to better assess the potential presence and hazard of ENMs in industrial wastewater (U.S. EPA, 2015b). These research activities include:

- Identifying the universe of ENM facilities, their production quantities, and the waste generated and disposed of during the manufacturing and processing of ENMs.
- Developing standard methods and sampling techniques to detect and characterize nanomaterials in industrial wastewater.
- Evaluating and characterizing the fate, transformation, and treatment of ENMs in industrial wastewaters.

As part of the current review, EPA continued its review of ENMs, focusing on new data and information available since the 2014 Annual Review. Although EPA focused on three classes of ENMs in its 2014 Annual Review, EPA did not limit its current review to only these ENMs, as the types of ENMs are evolving. The following sections provide an overview of ongoing efforts related to the relevant areas of research identified in the 2014 Annual Review, as well as research topics and trends being coordinated through the National Nanotechnology Initiative (NNI).[54] Section 6.1.1 presents EPA's current review ENM research methodology. Section 6.1.2 provides an update on research and information coordinated through NNI. Sections 6.1.3 through 6.1.5 summarize the current status of information related to the areas identified for further research.

6.1.1 Research Methodology

For the current review, EPA attended several workshops and conferences to gather updated information to inform the status of the areas for further research identified above. These workshops and conferences included:

- **QEEN Workshop: Quantifying Exposure to Engineered Nanomaterials (QEEN) from Manufacturing Products in Arlington, Virginia.** Sponsored by the Consumer Product Safety Commission (CPSC) in collaboration with the NNI. This workshop hosted governmental and nongovernmental organizations and experts to discuss current research on quantifying exposure at different stages of the ENMs life cycle and development of characterization tools and techniques. This workshop highlighted

[54] NNI is a collaborative, interagency U.S. government research and development initiative that provides a framework for individual and cooperative nanotechnology-related activities for 20 federal department and agency units, including EPA.

current and planned nanomaterial environmental, health, and safety research and the quantitative exposure assessments needed for responsible development of nanotechnology (CPSC, 2016).

- **NNI Strategic Planning Stakeholder Workshop in Washington, D.C.** Sponsored by the NNI, the goal of this workshop was to obtain input regarding the vision for the NNI and comments on key aspects of the 2016 NNI Strategic Plan (NNI, 2016) (see Section 6.1.2 for more information on the NNI Strategic Plan). EPA attended the workshop to gather new information related to research about ENMs, particularly as it related to characterizing and quantifying their presence in industrial wastewater discharge and understanding potential impacts.
- **2016 TechConnect World Innovation Conference & Expo in Washington, D.C.** Sponsored by TechConnect, a global technology outreach and development organization, the conference focused on trends in U.S. and international ENM technology, product development, commercialization, and investment opportunities (TechConnect, 2016). EPA attended this conference to understand current trends and future innovations related to production and use of ENMs.

As part of the continued review of ENMs, EPA also reviewed related and more recently published literature and research from workshop and conference participants, generally published since 2014, including new information published by NNI. EPA's ENM literature review was consistent with the ENM research methodology outlined in Section 6.1.1 of the 2014 Annual Review (U.S. EPA, 2015a). The literature sources include government publications and peer-reviewed journals, identified through internet search engines, such as American Chemical Society Publications and Google Scholar. Appendix A of this report provides information on data usability and the quality of data sources supporting this review.

6.1.2 The National Nanotechnology Initiative (NNI)

The NNI is a collaborative, U.S. government interagency research and development initiative. The NNI expedites the discovery, development, and deployment of nanoscale science and technology to serve the public good; this is accomplished through a program of coordinated research and development aligned with the missions of the participating agencies (NNI, 2016). NNI agencies and academic research centers coordinate research that may facilitate EPA's understanding of the potential for wastewater discharges from ENMs manufacturing and processing, as well as potential impacts on the environment.

In 2016, the NNI released their updated strategic plan for nanotechnology research and development. The plan centers on four goals: (1) advance a world-class technology research and development program; (2) foster the transfer of new technologies into products for commercial and public benefit; (3) develop and sustain educational resources, a skilled workforce, and a dynamic infrastructure and toolset to advance nanotechnology; and (4) support responsible development of nanotechnology (NNI, 2016).

In addition to the four goals released in the NNI 2016 Strategic Plan, NNI's environmental health and safety (EHS) strategic planning and trends in research will focus on five core categories: 1) nanomaterial measurement infrastructure; 2) human exposure assessment; 3) human health; 4) environment; and 5) risk assessment and risk management (NNI, 2011, 2016). As highlighted during the 2016 NNI Strategic Planning Stakeholder Workshop EHS research topics expected to trend over the next decade will include (NNI, 2016):

- Classification of ENMs by function and risk
- Measurement and detection tools
- Safety by design[55]
- Exposure and risk research using relevant exposure scenarios
- Chronic low dose studies of potential impacts on human health and the environment

The goals laid out in the NNI 2016 Strategic Plan, the fourth goal in particular, in addition to the EHS research topics expected to trend over the next decade, will likely address many of EPA's data gaps.

6.1.3 ENM Facility Universe, Production Quantities, and Wastewater Generation

Between 2006 and 2016, the Project on Emerging Nanotechnologies, a nanotechnology consumer products inventory compiled by the Woodrow Wilson International Center for Scholars and the Virginia Tech Center for Sustainable Nanotechnology, observed an 860 percent increase in the number of consumer products containing ENMs, representing a jump from 212 to 1,827 individual products (Project on Emerging Nanotechnologies, 2016; Roth, et al., 2015). Research continues to suggest that ENMs are used in a wide range of industrial applications and domestic products, including pharmaceuticals, paints, coatings, clothing, electronics, automotive applications, solar panel applications, pigments, and cosmetics (Judy, et al., 2015; Keller & Lazareva, 2014; Sun, et al., 2014).

Despite the variety of industries and applications that use or incorporate ENMs, EPA identified little detailed research regarding the potential presence of ENMs in aqueous waste streams or discharges from industrial activities. However, ENM use in the electronics industry seems to be one area of focus. EPA identified several studies evaluating ENM use within and wastewater generated from the electronics industry, specifically related to chemical mechanical planarization (CMP). CMP, a process that uses abrasive materials (including nanomaterials, such as ceria (CeO_2) and diamond nanoparticles) to thin, smooth, or polish surfaces, is used extensively for microelectronics manufacturing (Atiquzzaman, 2012).

CMP typically uses either a slurry or a fixed abrasive to polish electrical component surfaces. Both polishing methods rely on mechanical forces and chemical reactions to clean and remove excess material from the electrical component surface being polished. For the slurry method, a mixture of abrasive particles and chemical additives are placed on a polishing pad on a rotating plate. The fixed abrasive method is similar except that the abrasive is bonded to the polishing pad (Zazzera, et al., 2014).

Two case studies demonstrate that ENMs are present in wastewater generated from specific electronics manufacturing processes. Researchers at 3M Company compared ceria nanoparticle concentrations found in wastewater generated by slurry and fixed abrasive CMP and

[55] A concept that encourages assessment and minimization of health and safety risks during product design.

concluded that fixed abrasive CMP resulted in significantly lower concentrations of ceria nanoparticles released to wastewater than from slurry CMP. Using the slurry method, in which the nanoparticles are more mobile within the medium, the average mass of nanoparticles released per hour was approximately 30 times higher than the mass released from the fixed abrasive method (Zazzera, et al., 2014). This study demonstrates that ENMs, specifically ceria, are used in electronics polishing, are released to wastewater, and that the quantity released may be dependent upon the polishing method employed.

Researchers at SUNY Polytechnic Institute investigated the fate of nanoparticles from CMP wastewater at a semiconductor manufacturing facility through sampling at the facility's on-site wastewater treatment system. Samples were taken at multiple points throughout the treatment process and analyzed for the presence of nanomaterials using a scanning electron microscopy (SEM) technique with an energy-dispersive X-ray spectroscopy (EDX) detector. Nanomaterials were characterized as nearly-spherical, having a mean diameter of 54 nm, and containing the elements carbon, oxygen, silicon, and aluminum (although the study did not identify their origin (i.e., from CMP slurry or generated incidentally from an industrial process)). Results showed that nanoparticles in CMP wastewater may be captured incidentally by the conventional treatment system filters (two filters with 5 and 15 μm pore sizes, respectively), but the system was unequipped to specifically target removal of nanoparticles based on particle size (Roth, et al., 2015).

Nanoparticles were detected just prior to the point of discharge. In addition, the wastewater from this system was sent to a publicly owned treatment work (POTW) for further treatment. Researchers have expressed concern that ENMs may impact the biota integral to biological treatment processes, potentially reducing biological treatment performance (Roth, et al., 2015; Westerhoff, et al., 2013). The SUNY Polytechnic Institute study demonstrates that nanomaterials are present in wastewater discharges from the electronics industry and suggests that conventional treatment systems can effectively remove ENMs; however, further research may be needed to identify any correlation between nanoparticle size and removal rates.

Though limited data are available related to other industries that may manufacture, process, or use ENMs, EPA is in the process of gathering information about nanoscale materials through a final rule promulgated under the Toxic Substances Control Act (TSCA) section 8(a) (82 FR 3641). Effective August 14, 2017, the rule requires one-time reporting of chemical, manufacturing, and release information by manufacturers and processors of nanoscale materials. Within this rule, nanoscale materials are defined as materials containing particles within the size range of 1-100 nanometers (nm) in at least one direction and exhibiting one or more unique and novel properties different from properties at size ranges greater than 100 nm. Specific information to be collected includes chemical identity, production volume, methods of manufacture and processing, exposure and release, and available environmental, health and safety information. The information gathered under TSCA section 8(a) may facilitate EPA in identifying potential sources of ENM-containing wastewater.

6.1.4 ENM Standard Methods and Sampling Techniques

EPA's more recent research indicates that methods for detecting, quantifying, and characterizing nanomaterials in complex environmental media, such as industrial wastewater, are still not fully developed (CPSC, 2016; Part, et al., 2015). However, EPA has identified some advances in methods that rely on advanced microscopy or spectroscopy (e.g., hyperspectral imagery, scanning electron microscopy, confocal microscopy, energy-dispersive spectroscopy, near-infrared fluorescence), which have demonstrated success in detecting ENMs in some complex media (e.g., biological samples, wetland water, wastewater) (Badireddy, et al., 2012; CPSC, 2016; Part, et al., 2015; Selck, et al., 2016).

In general, academic and government researchers continue to use very sophisticated instrumentation to measure some of the most common ENM characteristics (e.g., particle size, shape, structure, surface area, concentration, agglomeration), but the appropriate analytical technique depends on the composition of ENM and the surrounding media. EPA's research suggests that standardizing methods to measure ENMs in complex media continues to be challenging due to the complexity caused by matrix issues, and the expense and limited availability of the instrumentation (Salamon, 2013; Selck, et al., 2016; von der Kammer, et al., 2012). To date, EPA has not approved standardized methods for sampling, detecting, monitoring, quantifying, or characterizing nanomaterials in aqueous media.

6.1.5 Fate, Transformation, and Treatment of ENMs in Industrial Wastewaters

EPA identified several modeling efforts which show that the fate of ENMs through their life cycle vary depending on application. For example, Researchers at the University of California Center for Environmental Implications of Nanotechnology estimated that 60 to 86 percent of ENMs used globally (with the majority from applications in electronics, motor vehicles, and solar panels) end up in landfills (Keller & Lazareva, 2014). Researchers at Empa, Switzerland, used probabilistic material-flow modeling to determine the life cycle of ENMs in the European Union. They showed that ENMs used in coatings, pigments, and cosmetics (i.e., TiO_2 and ZnO), primarily flow from production, manufacturing, and consumption (PMC) to wastewater treatment plants, and that carbon-based ENMs go largely from PMC to recycling facilities, or are burned (Sun, et al., 2014).

EPA did not identify research on the fate of ENMs specifically released by the production and manufacturing phases, though these life cycle assessments suggest that end of life (consumption of end use products) release may be a significant source of ENMs to POTWs. Regardless of the source, research continues to suggest that the majority of nanoparticles likely partition to sewage sludge (Eduok, et al., 2015; Kaegi, et al., 2013; Westerhoff, et al., 2011). Nanoparticles sorb to biomass and are subsequently removed from wastewater through settling or filtration during wastewater treatment; however, removal efficiency strongly depends on the size of the nanomaterials (Westerhoff, et al., 2011).

EPA's research suggests that characterizing ENMs and understanding their fate in industrial wastewater continues to be challenging due to interactions with other environmental substances and processes, which may alter ENM properties and behavior. Chemical reactions with an aqueous environment, such as adsorption of organic ligands, metals, and naturally occurring colloids, can cause modifications to the ENM surface and may alter the fate and bioavailability of the ENM, as compared to pristine ENMs, (Eduok, et al., 2015; Selck, et al., 2016), thus potentially affecting its behavior during biological wastewater treatment.

Research suggests that nanomaterials may impact the functionality of necessary biota in biological treatment processes, although the effects on biological removal of pollutants are not yet conclusive (Eduok, et al., 2015; Westerhoff, et al., 2013). Within laboratory testing, silver nanoparticles have been found to significantly inhibit nitrification rates by nitrifying bacteria, such as *Nitrosomonas* and *Nitrobacter* (Hristozov, et al., 2016) and reduce nitrifying capacity in a bioreactor (Westerhoff, et al., 2013). Researchers found that titanium dioxide nanoparticles showed no short-term effects on nutrient removal, but after long term exposure (70 days), decreased total nitrogen removal efficiency (Zheng, et al., 2011). Researchers at Cranfield University, UK, investigated the effects of a mixture of silver oxide, titanium dioxide, and zinc oxide ENMs on pilot biological wastewater treatment systems. They found that the ENM mixture inhibited ammonia and nitrite-oxidizing bacteria, while other microorganisms seemingly tolerant to the ENMs thrived. Although there was a shift in the microbial community structure and diversity, researchers did not observe any significant changes in removal of organic matter or ammonia (Eduok, et al., 2015).

On the other end of the spectrum, ENMs have shown promise when used in water and wastewater treatment systems, either as treatment chemicals or integrated into filter and membrane materials, to remove other pollutants of concern. The most studied ENMs for wastewater treatment are zero-valent metal nanoparticles (e.g., Ag, Fe, and Zn), metal oxide nanoparticles (e.g., TiO_2, ZnO, and iron oxides), and carbon nanomaterials (Lu, et al., 2016).

Zero-valent metal nanoparticles, such as zero-valent iron (ZVI) are being evaluated to remove various organic and inorganic pollutants in water, such as arsenic, hexavalent chromium, copper, and lead (Bora & Dutta, 2014). Researchers also found ZVI to be effective at decomposing nitrobenzene, a feedstock material used to produce pharmaceuticals, dyes, and pesticides (Lee, et al., 2015). Metal oxides are being evaluated for their potential to photocatalytically degrade organic compounds (e.g., humic acid, color, silver nitrate) and microorganisms harmful to human health, such as *E. coli* and *S. mutans* (Bora & Dutta, 2014).

Carbon nanomaterials are widely studied for use in membrane fabrication. Carbon nanotubes (CNTs) have high solvent permeability while blocking chemical and biological pollutants. Activated carbon is already extensively used as a sorbent to remove organic and inorganic chemicals from wastewater, and CNTs are being evaluated as adsorbent materials (Bora & Dutta, 2014). Though this body of research indicates promising uses of ENMs in wastewater treatment, it also signals another potential source of ENMs in wastewater discharges if the applications are not adequately controlled.

6.1.6 Summary of ENM Review

Based on the information gathered during EPA's current review, research continues to suggest that ENMs are used in a wide range of industrial applications and domestic products, but little is known about production quantities, waste management practices, or the potential for release of ENMs from most industrial waste streams. However, EPA has identified that nanomaterials, specifically ceria, used in CMP in the electronics industry may be released into wastewater and have the potential to be discharged to the environment. Further, the quantity of nanomaterials released varies with the process operations employed.

Methods for detecting and characterizing nanomaterials in complex media, including industrial wastewater, are under development. However, only incremental progress has been made to date towards developing standard measurement methods, which are needed before EPA can demonstrate the extent of ENMs in industrial discharges, and the efficacy of various wastewater treatment technologies to remove ENMs from industrial wastewater.

Some research suggests that ENMs may impact the effectiveness of biological wastewater treatment systems, with specific studies suggesting impacts to nitrification and nutrients removal. In contrast to those concerns, recent information suggests a trend toward using ENMs in water and wastewater treatment to remove or degrade specific pollutants, such as metals, organic compounds, and microorganisms. These treatment applications may also be a potential source of environmental release if not adequately managed.

Consistent with results from its 2014 Annual Review (U.S. EPA, 2015a), EPA will continue to identify data gaps related to (1) potential sources, quantities, and types of ENMs in industrial wastewater discharge; (2) fate, transformation, and treatment of ENMs in industrial wastewaters, including their potential impact to wastewater treatment system biota and beneficial use to enhance wastewater treatment, and (3) the development of standard methods to detect and quantify ENMs. Filling these data gaps will enable EPA to assess more fully the potential presence and impact of ENMs in industrial process water.

6.1.7 References

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6.2 Continued Review of Industrial Wastewater Treatment Technologies

The Clean Water Act (CWA) directs EPA to establish Effluent Limitations Guidelines and Standards (ELGs) based on the performance of the best treatment technologies available, application of best management practices, or implementation of process changes. As described in EPA's 2002 Draft National Strategy (67 FR 71165), EPA considers several factors when developing its Effluent Guidelines Program Plans, including the availability of wastewater treatment technologies. EPA may choose to revise existing ELGs for a point source category if it identifies an applicable and demonstrated technology, process change, or pollution prevention approach that would reduce the concentrations of pollutants in the discharged wastewater.

In its *Final 2012 and Preliminary 2014 Effluent Guidelines Program Plans* (79 FR 55472), EPA announced that it had initiated a review of relevant literature to document the performance of new and improved industrial wastewater treatment technologies. EPA captures these performance data in a searchable Industrial Wastewater Treatment Technology (IWTT) Database. IWTT is a critical component of EPA's annual reviews, including this review. EPA uses IWTT, in part, to answer the following questions:

- What new technologies or changes to existing technologies are industries using to treat their waste streams?
- Are there technologies that can reduce or eliminate wastewater pollutants not currently regulated by ELGs, or remove pollutants to a degree that exceeds current regulatory standards?

EPA's *2012 Annual Effluent Guidelines Review Report* (2012 Annual Review Report) (U.S. EPA, 2014) and *Supplemental Quality Assurance and Control Plan for Development and Population of the Industrial Wastewater Treatment Technology Database* (ERG, 2013) describe the IWTT data collection methods, data sources, data quality assurance and control criteria, and the proposed plan for data storage. The *2014 Annual Effluent Guidelines Review Report* (2014 Annual Review Report) (U.S. EPA, 2015) describes the database structure and the data elements captured. The 2014 Annual Review Report also provides a detailed summary of the information captured in the database at that time.

This section provides an updated overview of the data collected in IWTT to date. Sections 4.1, 4.2, 4.3, and 5.2 of this report present EPA's analysis of IWTT data related to specific industry category reviews, conducted as part of the current review.

6.2.1 Updated IWTT Literature Review Summary

EPA's initial efforts to build and populate IWTT are described in the 2014 Annual Review Report (U.S. EPA, 2015). Building upon prior data collection efforts, EPA continued to collect wastewater treatment performance data by identifying and screening 130 references from two key technical conferences on wastewater treatment. These conferences included presentations across a broad range of industries: 2015 Water Environment Federation's Technical Exhibit and Conference and 2015 International Water Conference.

EPA screened all identified literature and data sources against the established data quality criteria described in Section 6.6.1.3 of the 2012 Annual Review Report (U.S. EPA, 2014) and the

Supplemental Quality Assurance and Control Plan for Development and Population of the Industrial Wastewater Treatment Technology Database (ERG, 2013).

To date, EPA has identified and screened a total of 561 articles. Of those, 191 met the quality criteria and database entries were created for each article in IWTT. Appendix C comprises a complete bibliography of the articles that have been entered into the database to date.

6.2.2 Updated Summary of Data Captured in IWTT

EPA focuses on capturing wastewater treatment performance data (e.g., pollutant removals, influent and effluent concentrations) about pilot- and full-scale systems treating industrial wastewater. Table 6-1, Table 6-2, and Table 6-3 summarize the treatment technologies, industries, and pollutants documented in the database to date. The file *IWTT_Export_2016.xls* provides detailed output of the data in the IWTT Database (ERG, 2016).

The IWTT Database (*IWTT_Export_2016.xls*) currently contains data for 54 different treatment technologies (i.e., unit processes), some of which may be components of a larger treatment system (ERG, 2016). Table 6-1 lists the number of articles that describe each unit process, and the number of treatment systems that include each unit process. Twenty-eight treatment technologies, or 52 percent of the technologies in the database, are described in five or more articles. The treatment technology classifications were developed to capture and compare unit processes within a treatment system. In order to standardize information for evaluation across articles, treatment unit classifications vary in specificity. Appendix H of the 2014 Annual Review Report provides descriptions and categorization information about the treatment technologies (U.S. EPA, 2015).

Table 6-1. Pilot- and Full-Scale Treatment Unit Processes Documented in IWTT

Unit Processes	Number of Articles Describing the Technology	Number of Treatment Systems Using the Technology[a]
Chemical precipitation	41	52
Flow equalization	35	41
Membrane bioreactor	33	45
Clarification	33	38
Membrane filtration	24	34
Dissolved air flotation	22	29
Aerobic suspended growth	22	23
Reverse osmosis	19	21
Granular-media filtration	19	21
Mechanical pre-treatment	16	22
Ion exchange	16	20
Aeration	13	14
Oil/water separation	12	14
Bag and cartridge filtration	10	14
Anaerobic biological treatment	10	12

Table 6-1. Pilot- and Full-Scale Treatment Unit Processes Documented in IWTT

Unit Processes	Number of Articles Describing the Technology	Number of Treatment Systems Using the Technology[a]
Aerobic biological treatment	9	11
Anaerobic fixed film biological treatment	8	12
Aerobic fixed film biological treatment	7	9
Granular activated carbon unit	7	8
Ultra violet	7	8
Adsorptive media	7	7
Moving bed bioreactor	7	7
Evaporation	6	11
Electrocoagulation	6	9
Anaerobic suspended growth	6	8
Liquid extraction	6	7
Biological nutrient removal	6	6
Biologically active filters	6	6
Constructed wetlands	5	8
Advanced oxidation processes, NEC	5	6
Stripping	4	5
Chemical oxidation	4	5
Degasification	4	4
Ozonation	3	4
Centrifugal separator	3	4
Ballasted clarification	3	3
Nanofiltration	3	3
Chemical disinfection	3	3
Powdered activated carbon	3	3
Crystallization	2	7
Biological treatment	2	2
Controlled hydrodynamic cavitation	2	2
Anaerobic membrane bioreactor	2	2
Denitrification filters	2	2
Integrated fixed-film activated sludge	2	2
Dechlorination	2	2
Hydrolysis, acid or alkaline	1	2
Biofilm airlift suspension reactor	1	1
Bioaugmentation	1	1
Cloth filtration	1	1
Zero valent iron	1	1
Dissolved gas flotation	1	1
Distillation	1	1
Granular sludge sequencing batch reactor	1	1

[a] Some articles may describe more than one wastewater treatment system.

As shown in Table 6-2, IWTT contains wastewater treatment technology performance data for 27 out of the 58 industrial point source categories currently regulated by effluent guidelines.[56] IWTT also includes treatment technology performance data for two industries not currently regulated, as well as several unclassifiable establishments. IWTT captures the removal performance of treatment systems for 195 different pollutants. Table 6-3 lists the pollutants having their associated treatment performances most frequently reported in IWTT. Table D-1 in Appendix D presents the complete list of pollutants with documented treatment performance.

Table 6-2. Industries with Wastewater Treatment Performance Data in IWTT

Point Source Category No.	Industry	Scale of Treatment System	Number of Treatment Systems
--	Agricultural services (SIC codes beginning with 07, excluding veterinary services)	Pilot	1
--	Non-classifiable establishments	Full	2
		Pilot	5
405	Dairy products processing	Full	1
407	Canned and preserved fruits and vegetables processing	Full	1
		Pilot	2
410	Textile mills	Full	1
		Pilot	2
412	CAFO	Full	2
419	Petroleum refining	Full	9
		Pilot	12
420	Iron and steel manufacturing	Full	2
		Pilot	2
421	Nonferrous metals manufacturing	Pilot	3
423	Steam electric power generating	Full	4
		Pilot	3
424	Ferroalloy manufacturing	Pilot	1
425	Leather tanning and finishing	Full	4
430	Pulp, paper and paperboard	Full	2
		Pilot	1
432	Meat and poultry products	Full	4
		Pilot	3
433	Metal finishing	Full	3
		Pilot	19
434	Coal mining	Full	2
		Pilot	7

[56] https://www.epa.gov/eg/industrial-effluent-guidelines

Table 6-2. Industries with Wastewater Treatment Performance Data in IWTT

Point Source Category No.	Industry	Scale of Treatment System	Number of Treatment Systems
435	Oil and gas extraction	Full	2
		Pilot	8
437	Centralized waste treatment	Full	1
439	Pharmaceutical manufacturing	Full	3
		Pilot	1
440	Ore mining and dressing	Full	1
		Pilot	2
442	Transportation equipment cleaning	Full	1
445	Landfills	Full	1
455	Pesticide chemicals	Pilot	1
460	Hospital	Full	1
		Pilot	1
467	Aluminum forming	Full	1
469	Electrical and electronic components	Full	1
		Pilot	5
--	Miscellaneous foods and beverages	Full	3
		Pilot	6

-- Not a regulated point source category.

Table 6-3. Pollutants with Performance Data Most Frequently Reported in IWTT

Pollutant[a]	Number of Treatment Systems
Chemical oxygen demand (COD)	60
Total suspended solids (TSS)	49
Biochemical oxygen demand (BOD)	27
Total dissolved solids (TDS)	26
Phosphorus, total	23
Nitrogen, Kjeldahl total (TKN)	19
Total organic carbon (TOC)	18
Ammonia (as N)	17
Chemical oxygen demand (COD), total	16
Nitrogen, total	14
Selenium, total	13
Nickel	13
Conductivity	12
Chloride	12
BOD5	12
Oil and grease	12

Table 6-3. Pollutants with Performance Data Most Frequently Reported in IWTT

Pollutant[a]	Number of Treatment Systems
Copper	11
Nitrate (as N)	11
Cadmium	11
Chromium	10
Ammonia (as NH3)	10
Zinc	10
Ammonium-nitrogen	10

[a] Pollutant names are only as specific as the names stated in each article.

6.2.3 References for the Continued Review of Industrial Wastewater Treatment Technologies

1. ERG. 2013. Eastern Research Group, Inc. Supplemental Quality Assurance and Control Plan for the Development and Population of the Industrial Wastweater Treatment Technology Database. Chantilly, VA. (November 22). EPA-HQ-OW-2010-0824-0263.

2. ERG. 2016. Eastern Research Group, Inc. *Export of Industrial Wastewater Treatment Technology (IWTT) Database Tables*. Chantilly, VA. (September). EPA-HQ-OW-2015-0665. DCN 08383.

3. U.S. EPA. 2014. *The 2012 Annual Effluent Guidelines Review Report*. Washington, D.C. (September). EPA-HQ-OW-2010-0824-0320.

4. U.S. EPA. 2015. *The 2014 Annual Effluent Guidelines Review Report*. Washington, D.C. (July). EPA-HQ-OW-2014-0170-0209.

6.3 Continued Targeted Review of Pesticide Active Ingredients (PAIs) Without Pesticide Chemicals Manufacturing Effluent Limitations (40 CFR Part 455)

As part of the 2012 Annual Review, EPA reviewed analytical methods it had recently developed or revised to facilitate identification of pollutants in industrial wastewater discharges (U.S. EPA, 2014a), including a review of EPA Office of Water's 2012 updates to the test procedures for the analysis of pollutants under the Clean Water Act (CWA) (2012 Method Update Rule) (77 FR 29758). Based on changes made in the 2012 Methods Update Rule, EPA identified 30 pesticide active ingredients (PAIs) which do not currently have PAI-specific effluent limitations for pesticide chemicals manufacturing under the Pesticide Chemicals effluent limitation guidelines and standards (ELGs) (40 CFR Part 455), although some may have been considered during the development of the ELGs (U.S. EPA, 2014a). As part of the 2014 Annual Review, EPA evaluated the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) Section 3 registration status of these 30 PAIs and identified data sources that may shed further light on the status of manufacturing of these PAIs in the U.S. (U.S. EPA, 2015).

EPA followed up on the analyses conducted in the 2012 and 2014 Annual Reviews in the current review. Specifically, EPA further evaluated the 30 PAIs of interest to (1) learn if any are manufactured in the U.S., (2) identify wastewater discharges, and (3) review available environmental fate and human health information. EPA used data about the 30 PAIs of interest collected under the FIFRA, as well as discharge monitoring report (DMR), Toxics Release Inventory (TRI), and toxicology data.

Section 6.3.1 provides a background of the Pesticide Chemicals Category (40 CFR Part 455). Sections 6.3.2 through 6.3.5 present EPA's current review approach and evaluation of the 30 PAIs without PAI-specific effluent limitations for pesticide chemicals manufacturing under the Pesticide Chemicals ELGs, including its review of FIFRA, DMR, TRI, and toxicology data sources. Section 6.3.6 summarizes the results from EPA's current review.

6.3.1 Pesticide Chemicals Category Background

EPA last promulgated ELGs for the Pesticide Chemicals Category (40 CFR Part 455) in 1993 for facilities that manufacture organic and metallo-organic PAIs. These discharges are regulated under Subparts A and B, respectively. EPA also revised the ELGs in 1996 for facilities that formulate, package, and repackage pesticide products. These discharges are regulated under Subparts C and E. As such, the Pesticide Chemicals ELGs regulate wastewater discharges from four subcategories:

- Subpart A: Organic Pesticide Chemicals Manufacturing
- Subpart B: Metallo-Organic Pesticide Chemicals Manufacturing
- Subpart C: Pesticide Chemicals Formulating and Packaging
- Subpart E: Repackaging of Agricultural Pesticides Performed at Refilling Establishments

The ELGs define the following terms related to pesticides:

- *Pesticide.* Any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest.
- *Active ingredient.* An ingredient of a pesticide that is intended to prevent, destroy, repel, or mitigate any pest.
- *Pesticide chemicals.* The sum of all active ingredients manufactured at each facility covered by 40 CFR Part 455.
- *Formulation of pesticide products.* The mixing, blending, or diluting of one or more PAIs with one or more active or inert ingredients, without an intended chemical reaction, to obtain a manufacturing use product or an end-use product.

Subparts A and B set ELGs applicable to pesticide chemicals manufacturing processes resulting from the manufacture of organic PAIs (with a few exceptions) and organo-tin PAIs (Subpart A), and all metallo-organic PAIs containing arsenic, mercury, cadmium, or copper (Subpart B). Subpart A limitations depend on the PAI manufactured. For facilities manufacturing any organic PAI, Subpart A sets limitations for biochemical oxygen demand (BOD), total suspended solids (TSS), pH, and chemical oxygen demand (COD). For facilities manufacturing specific PAIs (40 CFR Part 455 Table 1), Subpart A sets additional limitations for nonconventional pollutants (including limitations on the discharge of the PAI) and priority pollutants. Subpart A does not set effluent limitations for all PAIs manufactured in the United States.

Subpart B prohibits all discharges of process wastewater pollutants by facilities manufacturing metallo-organic PAIs containing arsenic, mercury, cadmium, or copper (U.S. EPA, 1993a, 1993b). Subparts C and E regulate pesticide formulating, packaging, and repackaging (PFPR) facilities. Subpart C prohibits discharges of process wastewater pollutants unless the facility incorporates certain pollution prevention alternative practices. Subpart E prohibits all discharges of process wastewater pollutants (U.S. EPA, 1996). When the last revisions of the Pesticide Chemicals ELGs were promulgated, very few facilities manufactured individual PAIs, and some PAIs were manufactured at just one facility (U.S. EPA, 1993b).

During the 1993 Pesticides Chemicals ELG revisions, EPA evaluated the manufacturing processes associated with 29 of the 30 PAIs of interest identified for EPA's current review (EPA did not evaluate Tokuthion (prothiofos), see Table 6-4). As discussed above, if a facility manufactures an organic PAI (with some exceptions), Subpart A sets limitations for BOD, TSS, pH, and COD. However, in 1993, EPA did not establish PAI-specific limitations for any of the 30 PAIs of interest. PAI-specific limitations may not have been set for the following reasons: the PAI was not manufactured since 1986; analytical methods were unavailable for the PAI; all wastewater discharges containing the PAI were disposed of in deep wells subject to regulation under EPA's Underground Injection Control (UIC) program; or there was insufficient data on their treatability (U.S. EPA, 1993a).

6.3.2 Introduction to EPA's 2016 Targeted Review of PAIs Without Pesticide Chemicals Manufacturing Effluent Limitations

In its current review, EPA continued to investigate the 30 PAIs (listed in Table 6-4) that do not currently have PAI-specific effluent limitations for pesticide chemicals manufacturing under Subpart A in 40 CFR Part 455. Table 6-4 presents information on the regulation of the 30

PAIs under the Pesticide Chemicals ELGs (40 CFR Part 455) under Subpart A, as well as the FIFRA Section 3 registration status. See Section 6.3.3 for additional information on FIFRA.

Table 6-4. Registration Status for 30 PAIs

EPA Method	PAI Name	CAS Number	Registration Status in Accordance with FIFRA Section 3	Subject to PAI-Specific ELGs Under 40 CFR Part 455, Subpart A
608.1	Chlorobenzilate	510-15-6	All U.S. registrations have been canceled.	No
	Chloropropylate	5836-10-2	All U.S. registrations have been canceled.	No
	Dibromochloropropane	96-12-8	Never registered in the U.S.	No
	Etridiazole	2593-15-9	First registered in 1962; under registration review.	No
614.1	EPN	2104-64-5	All U.S. registrations have been canceled.	No
615	Dalapon	75-99-0	All U.S. registrations have been canceled.	No
617	Carbophenothion	786-19-6	All U.S. registrations have been canceled.	No
	Endosulfan sulfate	1031-07-8	Never registered in the U.S.	No
	Endrin aldehyde[a]	7421-93-4	Never registered in the U.S. All U.S. registrations of the parent compound, endrin, have been canceled.	No
	Heptachlor epoxide[b]	1024-57-3	Never registered in the U.S. All U.S. registrations of the parent compound, heptachlor, have been canceled.	No
	Isodrin	465-73-6	Never registered in the U.S.	No
	Strobane	8001-50-1	All U.S. registrations have been canceled.	No
619	Atraton	1610-17-9	Never registered in the U.S.	No
	Secbumeton	26259-45-0	Never registered in the U.S.	No
	Simetryn	1014-70-6	Never registered in the U.S.	No
622	Chlorpyrifos methyl	5598-13-0	First registered in 1985; under registration review.	No
	Coumaphos	56-72-4	First registered in 1958; under registration review.	No
	Ethoprop	13194-48-4	First registered in 1967; under registration review.	No
	Ronnel	299-84-3	All U.S. registrations have been canceled.	No
	Tokuthion	34643-46-4	Never registered in the U.S.	No
	Trichloronate	327-98-0	Never registered in the U.S.	No
622.1	Aspon	3244-90-4	All U.S. registrations have been canceled.	No
	Dichlofenthion	97-17-6	All U.S. registrations have been canceled.	No
	Famphur	52-85-7	All U.S. registrations have been canceled.	No
	Fenitrothion	122-14-5	First registered in 1975; under registration review. Only product registered in the U.S. is for formulating other insecticides. No end-use products registered in the U.S.	No
	Fonofos	944-22-9	All U.S. registrations have been canceled.	No

Table 6-4. Registration Status for 30 PAIs

EPA Method	PAI Name	CAS Number	Registration Status in Accordance with FIFRA Section 3	Subject to PAI-Specific ELGs Under 40 CFR Part 455, Subpart A
	Thionazin	297-97-2	All U.S. registrations have been canceled.	No
632	Fluometuron	2164-17-2	First registered in 1974; under registration review.	No
	Neburon	555-37-3	All U.S. registrations have been canceled.	No
	Oxamyl	23135-22-0	First registered in 1974; under registration review.	No

Source: (U.S. EPA, 2015)

Note: CAS Number – Chemical Abstracts Service Number

[a] Endrin aldehyde has never been a registered pesticide but is an impurity and breakdown product of a previously registered pesticide, Endrin. The Pesticide Chemicals ELGs (40 CFR Part 455) set a specific effluent limitation for Endrin.

[b] Heptachlor epoxide has never been a registered pesticide, but is a metabolite of a previously registered pesticide, Heptachlor. The Pesticide Chemicals ELGs (40 CFR Part 455) set a specific effluent limitation for Heptachlor.

EPA identified follow-up questions and data sources in the 2014 Annual Review that would provide additional information to show whether any of the 30 PAIs of interest are manufactured in the U.S. and are potentially present in industrial wastewater discharges. For the current review, EPA specifically focused on the following questions:

- Are any of the 30 PAIs of interest manufactured in the U.S.? If so, which facilities manufacture the PAIs?
- Are discharge data available for the PAIs of interest?
- Are toxicology data available for the PAIs of interest?

To answer these questions, EPA used multiple data sources, including EPA-managed databases (e.g., FIFRA Section 3 and Section 7 data) that contain confidential business information (CBI), and publicly available data (e.g., DMR, TRI, and toxicology data). Sections 6.3.3 through 6.3.5 discuss these data sources and the analyses performed.

6.3.3 Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) Data

FIFRA regulates pesticide distribution, sale, and use in the U.S. The Code of Federal Regulations (CFR) defines the following pesticide terms related to the implementation of FIFRA:

- *Pesticide product.* A pesticide in the particular form (including composition, packaging, and labeling) in which the pesticide is, or is intended to be, distributed or sold. The term includes any physical apparatus used to deliver or apply the pesticide if distributed or sold with the pesticide. (40 CFR Part 152.3)
- *Technical grade of the active ingredient (TGAI).* A material containing an active ingredient that (1) contains no inert ingredient, other than one used for purification of

the active ingredient; and (2) is produced on a commercial or pilot plant production scale (whether or not it is ever held for sale). (40 CFR Part 158.300)

- *Manufacturing Use Product (MUP).* Any pesticide product other than an end-use product. A product may consist of the technical grade of active ingredient only, or may contain inert ingredients, such as stabilizers or solvents. (40 CFR Part 158.300)
- *End-use product.* A pesticide product whose labeling (1) includes directions for use of the product (as distributed or sold, or after combination by the user with other substances) for controlling pests or defoliating, desiccating, or regulating the growth of plants, and (2) does not state that the product may be used to manufacture or formulate other pesticide products. (40 CFR Part 152.3 and 40 CFR Part 158.300)
- *Establishment.* Any site where a pesticide product, active ingredient, or device is produced, regardless of whether such site is independently owned or operated, and regardless of whether such site is domestic and producing a pesticide product for export only, or whether the site is foreign and producing any pesticide product for import into the United States. (40 CFR Part 167.3)
- *Produce.* To manufacture, prepare, propagate, compound, or process any pesticide, including any pesticide produced pursuant to Section 5 of the Act, any active ingredient or device, or to package, repackage, label, relabel, or otherwise change the container of any pesticide or device.[57] (40 CFR Part 167.3)

Section 3 of FIFRA outlines pesticide registration in the U.S. and provides EPA the authority to regulate the content and labeling of pesticide products. Pesticide products include TGAIs, MUPs, and end-use products, as defined above. TGAIs are chemically equivalent to PAIs (as defined in the ELGs); for clarity within this report and to remain consistent with the terminology established in the Pesticide Chemicals ELGs, EPA uses the term PAI in this report. PAIs are sold as MUPs. The MUPs may consist of the PAI only or the PAI and small amounts of inert ingredients. MUPs are mixed with inert ingredients to formulate end-use products (Robbins, 2016).

FIFRA Section 3 requires registration of pesticide products distributed or sold for use within the U.S. (Keigwin, 2014; U.S. EPA, 2014b). The MUP, and the PAI it contains, must be registered before the end-use product containing it can be registered (Robbins, 2016; U.S. EPA, 2016a). FIFRA Section 4 requires that pesticide product registrations, including the PAI registration, be reviewed every 15 years and requires EPA to reregister all pesticide products registered before 1984 in order to update labeling and use requirements. EPA may cancel a registration if the pesticide product does not comply with any one of the FIFRA requirements. After cancellation, any distribution, sale, or use of the pesticide product within the U.S. is prohibited (U.S. EPA, 2012a). EPA's Office of Pesticides Programs (OPP) integrated system, Pesticide Registration Information System (PRISM) maintains information on U.S. pesticide registration and review as required under FIFRA Section 3. PRISM provides a centralized source of information on all registered pesticide products; the data contained in PRISM are considered

[57] The use of the term "produce" throughout the remainder of this report section refers to this FIFRA-specific definition, see 40 CFR 167.3.

CBI (U.S. EPA, 2016b). Table 6-4 presents the FIFRA Section 3 registration status for the 30 PAIs.

Although Section 3 of FIFRA provides the authority to regulate the content and labeling of pesticide products through registration, it does not provide the authority to regulate pesticide manufacturing. Pesticide products manufactured for distribution in the U.S. are exempt from Section 3 under certain circumstances, and pesticide products manufactured solely for export do not require U.S. registration. Therefore, the registration status of a particular pesticide product (e.g., canceled, never registered) may not indicate which pesticide products are manufactured in the U.S., especially if they are only manufactured for export (Keigwin, 2014).

Section 7 of FIFRA requires all domestic and foreign establishments[58] producing pesticide products to register with the appropriate EPA Regional office and to report the types and amounts of pesticide products they produce (U.S. EPA, 2012a). FIFRA Section 7 reporting includes facilities manufacturing pesticide products solely for export (Keigwin, 2014; U.S. EPA, 2012a). The FIFRA Section 7 data are compiled in the Section Seven Tracking System (SSTS) database. The SSTS database is considered a part of the PRISM system. The names of establishments producing PAIs and their annual production volumes in the SSTS database are considered CBI (U.S. EPA, 2016c).

Section 6.3.3.1 presents the methodology EPA used to review the FIFRA data, including details on the PRISM and SSTS databases, contents, and limitations. Section 6.3.3.2 presents the results from EPA's review of FIFRA Section 3 and Section 7 data.

6.3.3.1 FIFRA Data Methodology

EPA reviewed information on the 30 PAIs of interest in the PRISM and SSTS databases. PRISM contains information on all pesticide products registered under FIFRA Section 3, including MUPs (both those consisting entirely of PAIs and those with a small percentage of other inert ingredients) and end-use products. SSTS contains information on individual facilities registered under FIFRA Section 7 and the products they produce, including MUPs and end-use products.

Pesticide Registration Information System (PRISM) Database

The PRISM database contains FIFRA Section 3 information on all registered pesticide products in the U.S. EPA's Office of Water (OW) contacted EPA's OPP to discuss the quality and limitations of the information provided in PRISM and to access it for this review. The data collected in PRISM are particularly useful for the current review because PRISM:

- Includes the registration status for pesticide products that are produced (as defined in 40 CFR Part 167.3) in the U.S. for distribution, sale, or use within the U.S., including those with cancelled registrations.
- Identifies pesticide products by product name.

[58] As noted above, an establishment includes any site where a pesticide product, active ingredient, or device is produced, including sites that are independently owned or operated, domestic sites that produce a pesticide product for export only, and foreign sites that produce any pesticide product for import into the United States.

- Identifies pesticide products by chemical ingredients, including PAIs that make up MUPs or are components of end-use products.

The information provided in PRISM is particularly useful because it provides a method to identify the PAI chemical and brand names to use in searching the SSTS database. Despite its utility, EPA recognizes that there are limitations to the data provided in the PRISM database. The database only includes information on pesticide products registered under FIFRA Sections 3 and 4 for distribution, sale, or use within the U.S., and therefore, does not indicate whether the pesticide product is currently manufactured in the U.S. It does not include information for pesticide products exempt from Section 3 registration, or for products that may be manufactured in the U.S. for export only. Despite these limitations, EPA determined that the information provided in PRISM was sufficiently accurate, reliable, and representative for this review, specifically to identify the current registration status of the 30 PAIs of interest and identify alternative pesticide product names (including MUPs) under which the PAIs may be included or sold.[59]

Section Seven Tracking System (SSTS) Database

The SSTS database contains information on establishments producing (as defined by 40 CFR 167.3) pesticide products, including MUPs. The SSTS database contains the following information:

- General establishment and company information (e.g., name, contact information).
- Product registration status and information.
- Product name (e.g., common brand names, alternate brand names).
- Product classification (e.g., insect repellant, herbicide, rodenticide).
- Product type (e.g., MUP (also called "Technical" products in SSTS) or PAI, end-use product, repackaged, or relabeled).
- Market status in the U.S. (e.g., marketed in the U.S., marketed in the U.S. and exported, solely exported).
- "Restricted Use" pesticide status.
- Amount produced.
- Amount sold or distributed in the U.S.
- Amount sold or distributed to foreign markets.
- Amount estimated to be produced in the following year.

Any information in SSTS that links an establishment or company to a product, and the amount of production, is considered CBI. EPA's OW contacted EPA's OPP to discuss the quality and limitations of the information provided in SSTS and to access it for this review (Ruple, 2016). Establishments are required to submit Section 7 registration requests and annual data to their EPA regional pesticide establishment coordinator. However, the SSTS database is not a required reporting method for establishments. Therefore, the database may not contain the

[59] See Appendix A of this report for more information on data usability and the quality of data sources supporting these reviews.

same up-to-date or comprehensive information on production quantities that has been submitted to EPA regions.

The SSTS database is searchable only by pesticide product brand or trade name; it is not possible to search it by PAI or Chemical Abstracts Service Registry Number (CAS Number). Accordingly, EPA's search for information on the manufacture of PAIs and MUPs consisting of PAIs was limited to products whose brand or trade names that could be identified. Additionally, the SSTS database does not distinguish whether an establishment is manufacturing and/or formulating pesticide products, and it may not contain the same up-to-date or comprehensive information on production quantities that the establishment submitted to EPA regions, as discussed above. Despite these limitations, EPA determined that the information in SSTS was sufficiently accurate, reliable, and representative for this review, specifically to identify establishments producing MUPs that contain the PAIs of interest, which would indicate the potential for their manufacture in the U.S.[60]

Other Data Sources

As discussed above, there are some gaps in the PRISM and SSTS data. Therefore, EPA reviewed additional databases, including two publicly available chemistry databases: the National Institutes of Health (NIH) PubChem database and the Pesticide Action Network (PAN) Pesticides database. EPA used these databases to compile additional brand and trade names for each PAI (Kegley, et al., 2016; NCBI, 2016).

EPA also searched two additional OPP databases: the Foreign Purchaser Acknowledgement Statement (FPAS) database, to identify any exports of the PAIs of interest, and the Office of Pesticides Programs Information Network (OPPIN) database, EPA OPP's predecessor database to PRISM, to identify the registered intended use of each PAI in the U.S. (OPPIN, 2016). The data contained in these databases are considered CBI.

Methodology for Searching PRISM and SSTS

Figure 6-1 summarizes the basic methodology that EPA followed for extracting information from the PRISM and SSTS databases.

[60] See Appendix A of this report for more information on data usability and the quality of data sources supporting these reviews.

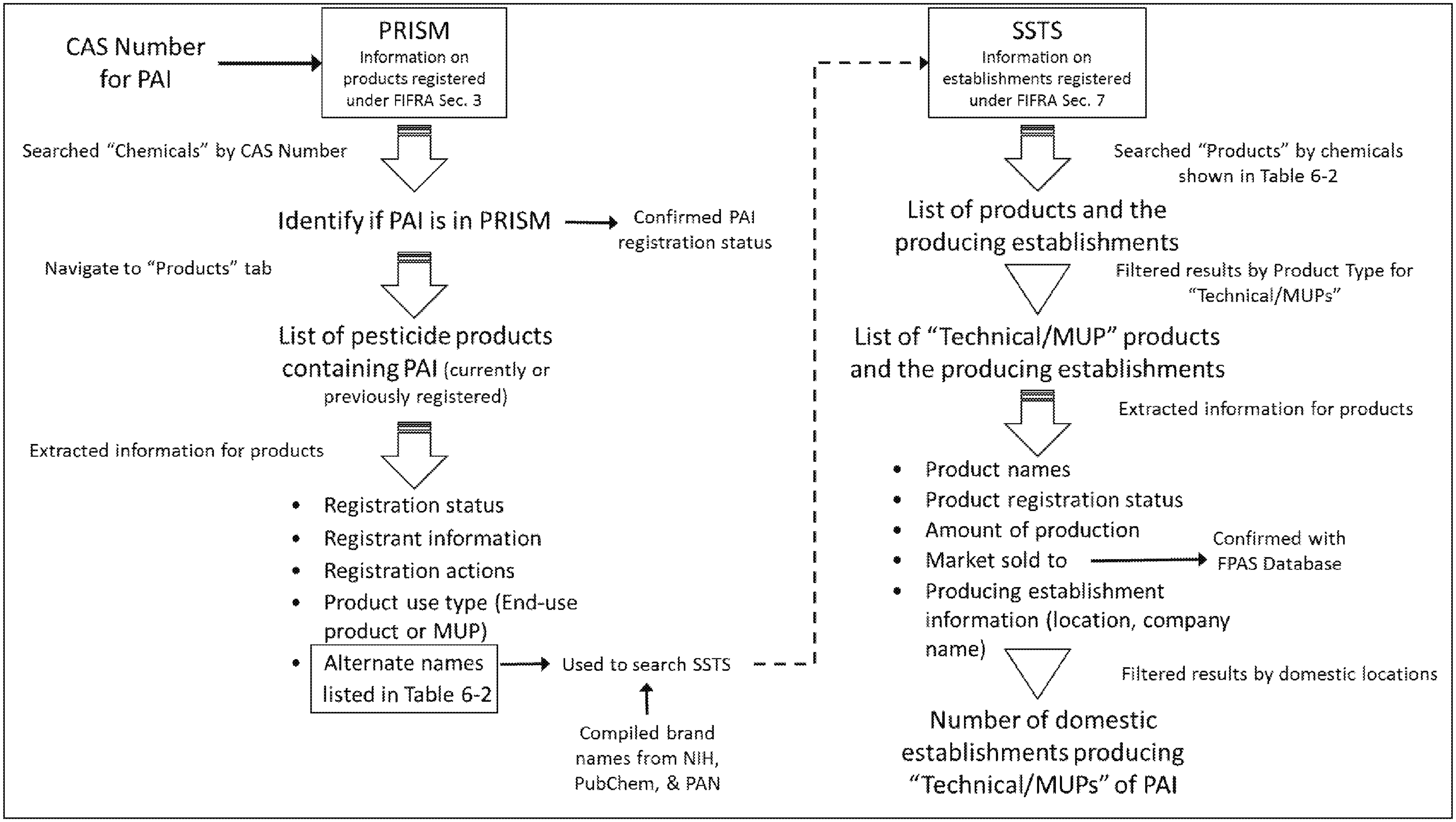

Figure 6-1. Methodology Used in the Current Review to Access FIFRA Data through the PRISM and SSTS Databases and Identify Facilities Potentially Manufacturing PAIs

Every chemical substance described in scientific literature is assigned a unique numeric identifier, a CAS number, by the Chemical Abstracts Service (Chemical Abstracts Service, 2016). Each of the 30 PAIs of interest has a unique CAS Number (listed in Table 6-5), despite potentially being sold under a variety of MUP brand or trade names. The PRISM database interface allows the user to search for chemicals by CAS Number. If the resulting identified PAI has ever been registered under FIFRA Section 3, additional information is available, including alternative chemical names, a list of all currently or previously registered pesticide products containing the PAI (MUPs and/or end-use products), and the PAI's current registration status. EPA performed this search for each of the 30 PAIs of interest and used the results to identify chemical names and to confirm each PAI's registration status (listed in Table 6-1). EPA also compiled the brand and trade names associated with the pesticide products containing the PAIs to facilitate comprehensive searches in the SSTS database for establishments potentially producing the PAIs (listed in Table 6-5).

To supplement the information found in PRISM, EPA searched the NIH PubChem database, and the PAN Pesticides database by PAI CAS Number to compile additional potential brand and trade names for each PAI (Kegley, et al., 2016; NCBI, 2016). The NIH and PAN databases were used in conjunction with PRISM to ensure that the search for information in SSTS was comprehensive, particularly in cases where an MUP may be manufactured in the U.S. only for export, and therefore, would not be identified in PRISM. EPA included the alternative names in Table 6-5.

Table 6-5. Alternative Names for Pesticide Products Containing PAIs

PAI Name	CAS Number	Chemical Name in PRISM	Brand or Trade Names
Aspon	3244-90-4	O,O,O,O-Tetrapropyl dithiopyrophosphate	NPD
Atraton	1610-17-9	1,3,5-Triazine-2,4-diamine, N-ethyl-6-methoxy-N'-(1-methylethyl)-	Atratone, Atrazine-methoxy, Atrotan, Gesatamin
Carbophenothion	786-19-6	None identified	Acarithion, Akarithion, Cabofenotion, Carbofenothion, Carbofenthion, Dagadip, Endyl, Garrathion, Hexathion, Karbofenothion, Lethox, Nephocarp, Oleokarithion, Rithion, Trithion
Chlorobenzilate	510-15-6	Ethyl 4,4'-dichlorobenzilate	Acar, Akar, Ben-O-chlor, Benzilan, Benzilen, Benz-O-chlor, Chlorbenzilat, Chlorobenzylate, Folbex, Kop-mite, Kopmite
Chloropropylate	5836-10-2	Isopropyl 4,4'-dichlorobenzilate	Acaralate, Chlormite, Chloropropylat, Chlorpropylat, Chlorpropylate, Gesakur, Rospan, Rospine, Rospine
Chlorpyrifos methyl	5598-13-0	None identified	Chlormethylfos, Chloropyriphos methyl, Chlorpyriphos methyl, Dursban methyl, Noltran, Reldan, Storcide, Trichlormethylfos, Tumar, Zertell
Coumaphos	56-72-4	None identified	Agridip, Asunthol, Asuntol, Azunthol, Balcom, Baymix, Checkmite, Co-ral, Corathon, Coumafos, Coumafosum, Coumarin, Cumafos, Cumafosum, Diolice, Meldane, Meldone, Muscatox, Negashunt,

Table 6-5. Alternative Names for Pesticide Products Containing PAIs

PAI Name	CAS Number	Chemical Name in PRISM	Brand or Trade Names
			Negasunt, Resitox, Suntol, Umbelliferone, Umbethion
Dalapon	75-99-0	None identified	Alatex, Basfapon, Basinex, Crisapon, Dalaphon, Dalascam, Davpon, Dawpon, Fydulan, Granulat, Kenapon, Liropon, Omnidel, Proprop, Radapon, Tafapon, Tripon, Unipon, Uropon
Dibromochloropropane	96-12-8	1,2-Dibromo-3-chloropropane	DBCP, Fumagon, Fumazone, Nemabrom, Nemafume, Nemagon, Nemagone, Nemanax, Nemanex, Nemapaz, Nemaset, Nemaset, Nemazon
Dichlofenthion	97-17-6	None identified	Bromex, Dichlophenthion, ECP, Hexanema, Mobilawn, Nemacide
Endosulfan sulfate	1031-07-8	6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-6,9-methano-2,4,3-benzodioxathiepin-3,3-dioxide	Thiodan sulfate
Endrin aldehyde	7421-93-4	None identified	None identified
EPN	2104-64-5	O-Ethyl O-(p-nitrophenyl) phenylphosphonothioate	Kasutop, Meidon, Santox, Tsumaphos
Ethoprop	13194-48-4	None identified	Ethioprophos, Ethoprophos, Etoprofos, Jolt, Menap, Mobil, Mocap, Phophos, Phosethoprop, Prophos, Rovokil
Etridiazole	2593-15-9	None identified	Aaterra, Banrot, Echlomezole, Echlomezole, Etcmtb, Ethazol, ETMT, Etridiazol, Koban, Pansoil, PCNB, Pentachloronitrobenzene, Planvate, Temik, Terraclor, Terracoat, Terraflo, Terramaster, Terrazole, Truban
Famphur	52-85-7	Phosphorothioic acid, O-(4-((dimethylamino)sulfonyl)phenyl) O,O-dimethyl ester	Bash, Bo-Ana, Dovip, Famfur, Famofos, Famophos, Fanfos, Warbex, Warbexol
Fenitrothion	122-14-5	None identified	Accothion, Aceothion, Agria, Agriya, Agrothion, Akotion, Arbogal, Cekutrothion, Cyfen, Cytel, Dicofen, Falithion, Fenition, Fenitox, Folithion, Insectigas, Kotion, Macbar, Metathion, Metathione, Metathionine, Metation, Methylnitrophos, Mglawik, Nitrophos, Novathion, Nuvanol, Oleometathion, Oleosumifene, Ovadofos, Owadofos, Owadophos, Sumigran, Sumithion, Sumitomo, Verthion
Fluometuron	2164-17-2	None identified	Cortoran, Cotogard, Cotoran, Cottonex, Flomet, Flo-Met, Fluomethuron, Higalcoton, Kotoran, Lanex, Meturon, Pakhtaran, Shotaran

Table 6-5. Alternative Names for Pesticide Products Containing PAIs

PAI Name	CAS Number	Chemical Name in PRISM	Brand or Trade Names
Fonofos	944-22-9	None identified	Difonate, Difonatul, Dyfonat, Dyfonate, Dyphonate
Heptachlor epoxide	1024-57-3	None identified	Epoxyheptachlor, Velsicol
Isodrin	465-73-6	None identified	None identified
Neburon	555-37-3	None identified	Granurex, Herbalt, Kloben, Naburon, Neburea, Neburex
Oxamyl	23135-22-0	None identified	Dioxamyl, Oxamil, Thioxamyl, Vydate
Ronnel	299-84-3	None identified	Blitex, Deramafosu, Dermafos, Dermaphos, Ectoral, Etrolene, Fenchloorfos, Fenchlorfos, Fenchlorfosu, Fenchlorophos, Fenchlorphos, Fenchofos, Fenclofosum, Fenclos, Gesektin, Korlan, Korlane, Nanchor, Nanker, Nankor, Phenchlorfos, Pyrocide, Remelt, Rid-Ezy, Rovan, Smear, Trichlorometafos, Trolene, Viozene
Secbumeton	26259-45-0	1,3,5-Triazine-2,4-diamine, N,N'-diethyl-6-(methylthio)-	Etazin, Etazine, Ezitan, Isobumeton, Secbumetone, Secumbeton, Sumitol, Terbut
Simetryn	1014-70-6	None identified	Cymetrin, Simetryne
Strobane	8001-50-1	None identified	Citicide, Polychloroterpenes, Terpene polychlorinates
Thionazin	297-97-2	O,O-Diethyl O-2-pyrazinyl phosphorothioate	Cynem, Cynophos, Nemafos, Nemafos, Nemaphos, Thinozim, Thionazine, Zinofos, Zinophos, Zynophos
Tokuthion	34643-46-4	O-(2,4-Dichlorophenyl) O-ethyl S-propyl phosphorodithioate	Bideron, Dichlorpropaphos, Prothiofos, Prothiophos, Toyodan, Toyothion
Trichloronate	327-98-0	O-Ethyl O-(2,4,5-trichlorophenyl) ethylphosphonothioate	Agrisil, Agritox, Fenophosphon, Fitosol, Phytosol, Richloronate, Trichloronat

Source: (Kegley, et al., 2016; NCBI, 2016; U.S. EPA, 2016a)

EPA then used the compiled names listed in Table 6-5 to search the SSTS database (as the SSTS database is not searchable by CAS Number). The SSTS database does not indicate whether an establishment is manufacturing or formulating pesticide products, so EPA cannot conclude whether the establishments identified in its search are manufacturing or formulating the PAIs of interest. For instance, establishments could manufacture MUPs consisting of the PAI only, and therefore, may manufacture the PAI on premise. Alternatively, the establishment could formulate MUPs that consist of the PAI and a small proportion of inert ingredients, such as stabilizers. These establishments may either manufacture the PAI on premise, and immediately incorporate it into a MUP, or could purchase the PAI from another manufacturer, including a foreign manufacturer, and then formulate the MUP. Similarly, establishments producing end-use products could also manufacture a PAI on premise for immediate incorporation into the product, without ever distributing or selling the PAI in a MUP. However, establishments producing end-use products usually purchase PAIs from other domestic or foreign manufacturers (Niess, 2016).

Given the above scenarios, EPA focused its review of the SSTS database on establishments producing MUPs to narrow the focus, to the extent possible, to the PAIs that are most likely manufactured in the U.S.[61] The SSTS database interface allows the user to search for establishments by the Product Name. The resulting list of products and their corresponding establishments can then be filtered by Product Type for "End- Use Product" or "Technical/MUP."

EPA searched for each of the 30 PAIs using the names listed in Table 6-5, filtering on the Product Type "Technical/MUP." The resulting list of MUPs contains detailed information including product name, product registration status, producing establishment name, location and contact information, the amount of annual production from that establishment, and the market to which the product is sold (e.g., domestic, foreign, or both). EPA used this information to identify the establishment names and locations producing MUPs in the U.S., regardless of whether the MUPs are being sold in the U.S. or foreign markets.

6.3.3.2 Summary of the FIFRA Data Review

From its review of PRISM and SSTS data, EPA confirmed that seven of the 30 PAIs are currently registered under FIFRA Section 3. Four of the seven registered PAIs are produced as MUPs at facilities in the U.S. In addition, EPA identified one PAI that has never been registered, but is produced as MUPs at U.S. establishments for export. Table 6-6 presents information on the eight PAIs that are currently registered under FIFRA Section 3 and/or included in MUPs produced in the U.S.

EPA has acknowledged the limitations of the databases from which this information was compiled. Neither the PRISM or SSTS databases provide information to indicate whether the identified establishments manufacture or formulate these PAIs. Additionally, the SSTS database may not be up-to-date and comprehensive, as it is not a required method of reporting. Therefore, the list of five PAIs that EPA identified as produced by U.S. establishments may not be a complete or fully accurate compilation of all PAIs potentially manufactured in the U.S.

Due to the limitations of the PRISM and SSTS databases discussed above, EPA OW also consulted with EPA OPP to understand if any of the unregistered PAIs are in exported MUPs. If a U.S. company exports an unregistered pesticide product (including MUPs and end-use products), they must submit a Foreign Purchaser Acknowledgement Statement (FPAS), which includes the CAS Numbers of any active ingredients in the products. EPA OPP searched the FPAS database by PAI CAS Number to find any exports of unregistered products since 2011. Consistent with the information presented in Table 6-6, OPP confirmed through FPAS records that the unregistered PAI Tokuthion is exported as MUPs to foreign markets, and that no other unregistered PAIs are exported in pesticide products.

[61] EPA focused its review on the PAIs most likely manufactured in the U.S. because, as described in Section 6.3.1, 40 CFR Part 455 Subparts A and B regulate conventional pollutants, nonconventional pollutants (including some, but not all, PAIs), and priority pollutants from pesticide chemical manufacturers that manufacture PAIs. EPA notes that the formulating and packaging of PAIs are subject to zero discharge standards under Subparts C and E, unless the facility incorporates certain pollution prevention alternative practices.

To gather more information on the PAIs that are registered and/or identified as being produced as MUPs in the U.S. (listed in Table 6-6), EPA consulted the OPPIN database to identify the registered intended use of each PAI in the U.S. When registered in the U.S., PAIs are designated for specific uses (OPPIN, 2016). Table 6-6 also provides the uses of the PAIs.

Table 6-6. FIFRA Information for Eight PAIs Registered and/or Included in MUPs Produced in U.S.

PAI Name	CAS Number	Registration Status in PRISM Database	Pesticide Use	MUP Containing PAI registered in PRISM	Number of U.S. Establishments Producing MUP Containing PAI in SSTS	Export Status from the U.S.	Market
Chlorpyrifos methyl	5598-13-0	First registered in 1985; under registration review.	Insecticide	Yes	0	Exported	U.S. & Foreign
Coumaphos	56-72-4	First registered in 1958; under registration review.	Insecticide	Yes	3	Not exported	U.S.
Ethoprop	13194-48-4	First registered in 1967; under registration review.	Insecticide	Yes	2	Exported	U.S. & Foreign
Etridiazole	2593-15-9	First registered in 1962; under registration review.	Fungicide	Yes	3	Exported	U.S. & Foreign
Fenitrothion	122-14-5	First registered in 1975; under registration review. Only product registered in the U.S. is for formulating other insecticides. No end-use products registered in the U.S.	Insecticide	Yes	0	Not exported	U.S.
Fluometuron	2164-17-2	First registered in 1974; under registration review.	Herbicide	Yes	0	Not exported	U.S.
Oxamyl	23135-22-0	First registered in 1974; under registration review.	Insecticide	Yes	2	Exported	U.S. & Foreign
Tokuthion (Prothiofos)	34643-46-4	Never registered in the U.S.	Insecticide	No	2	Exported	Foreign

Sources: (OPP, 2016; OPPIN, 2016; U.S. EPA, 2016a, 2016b, 2016c)

6.3.4 DMR and TRI Data

As part of the current review, EPA also reviewed available DMR and TRI data to evaluate if any of the five PAIs identified in Section 6.3.3 are present in industrial wastewater discharges. EPA searched recent DMR and TRI data for all five PAIs using parameter codes identified based on the PAI CAS Number (ERG, 2016).[62] The DMR and TRI data provide the most comprehensive source of information on current wastewater discharges in the U.S. However, neither dataset provides a comprehensive overview of the PAIs present in industrial wastewater discharges because the PAIs do not currently have PAI-specific effluent limitations for pesticide chemicals manufacturing under the Pesticide Chemicals ELGs. Thus, the five PAIs are included on DMRs only if the permitting authority has established a specific limit or monitoring requirement in the facility's permit. In addition, only a subset of PAIs are TRI-listed chemicals, for which facilities would be required to report releases under the TRI program. See Section 2.1 of this report for a general discussion of the usefulness and limitations of the DMR and TRI data and further details on the compiled data.

EPA reviewed 2010 through 2015 DMR data from facilities reporting any of the five PAIs. EPA also reviewed 2010 through 2015 DMR data from publicly owned treatment works (POTWs) reporting any of these five PAIs because POTWs may receive wastewater from an indirect discharging pesticide chemical manufacturer producing PAIs.

EPA also reviewed TRI reporting requirements and 2010 through 2015 TRI water release data. EPA identified that only one of the five PAIs, Ethoprop, is a TRI-listed chemical.

Table 6-7 summarizes the DMR and TRI data compiled for the five PAIs. Only one of these PAIs, Oxamyl, has reported discharges from three POTWs. EPA has not investigated whether POTWs with discharges containing PAIs originate from pesticide chemical manufacturing facilities or other sources such as pesticide use. From 2010 through 2015, no industrial facilities reported DMR or TRI discharges of the five PAIs. However, as previously discussed, the DMR and TRI datasets are limited. Therefore, the DMR and TRI discharges that EPA identified for the five PAIs may not be exhaustive.

Although EPA identified PAI discharges in the DMR and TRI datasets, EPA lacks sufficient information to tie these discharges to facilities manufacturing specific PAIs. In addition, discharges reported to DMR and TRI may result from packaging or formulating facilities or contamination present in the environment (e.g., pesticide use), which are not in the scope of discharges from pesticide chemical manufacturers addressed by the ELG.

[62] A parameter code is a unique five-digit number code used in DMR and TRI data to specify each unique pollutant.

Table 6-7. Summary of DMR and TRI Data Collected for 2016 Review of the PAIs of Interest

PAI Name	CAS Number	TRI 2010 through 2015		DMR 2010 through 2015	
		TRI Listed Chemical	Number of Facilities with Pollutant Load Greater Than Zero	Number of POTWs with Pollutant Load Greater Than Zero	Number of Non-POTWs with Pollutant Load Greater Than Zero
Coumaphos	56-72-4				
Ethoprop	13194-48-4	✓	0		
Etridiazole	2593-15-9				
Oxamyl	23135-22-0			3	0
Tokuthion (Prothiofos)	34643-46-4				

Source: (ERG, 2016)

6.3.5 Toxicology Data

The presence in the environment of PAIs identified in Section 6.3.3 may be due to the discharge of wastewater during their manufacture and/or during their formulation, or due to soil and groundwater contamination resulting from their use in nearby areas.

To understand the potential fate and transport of these PAIs in the environment, EPA compiled environmental fate information using the National Oceanic and Atmospheric Administration (NOAA) Chemical Aquatic Fate and Effects (CAFE) Database (NOAA, 2016a). Table 6-8 summarizes the environmental fate data for the five PAIs identified in Section 6.3.3. The chemical and physical parameters listed determine the tendency and extent of the environmental fate processes for each PAI.

Each chemical or physical parameter listed in Table 6-8 determines the environmental fate effects of the PAIs of interest. An explanation of each parameter is listed below.

- The *soil organic carbon-water partitioning coefficient (Koc)* is correlated to soil mobility, or the potential for chemicals to leach through soil and be introduced to groundwater. Lower values of Koc correspond to more mobility in soils, and higher Koc values corresponds to less mobility (NOAA, 2016b).
- The octanol/water partition coefficient (Log Kow) correlates to a chemical's polarity and partitioning to organic matter, with a higher Log Kow indicating a higher likelihood of partitioning into organic matter in soil, of absorbing into suspended sediments, and of bioconcentrating in organisms (NOAA, 2016b). Log Kow values less than 1 indicate high solubility in water; values 2-4 indicate moderate solubility and a tendency to absorb through skin; values greater than 4 are hydrophobic; and values greater than 5 tend to bioconcentrate in organisms' membranes (U.S. EPA, 2012b).
- Water solubility reflects the maximum amount of a chemical that will dissolve in pure water at a specified temperature.

- Henry's Law Constant indicates a chemical's volatility from water, or its tendency to transition from the liquid phase to vapor. Values between 10^{-3} and 10^{-5} are moderately volatile from water; values between 10^{-5} and 10^{-7} are slightly volatile from water; and values less than 10^{-7} are nonvolatile (U.S. EPA, 2012b).
- The vapor pressure is indicative of a chemical's volatility, with higher vapor pressure indicating higher volatility.

Environmental fate data are available for all five of the PAIs identified in Section 6.3.3. While the chemical and physical parameters for the PAIs may differ under varying environmental conditions, the environmental fate and transport data for some PAIs indicate tendencies to persist in the environment (Coumaphos, Tokuthion), mobilize to groundwater (Ethoprop, Etridiazole, Oxamyl), and bioconcentrate in organisms (Tokuthion).

Table 6-8. Environmental Fate Data for PAIs of Interest

		PAI Name				
		Coumaphos	**Ethoprop**	**Etridiazole**	**Oxamyl**	**Tokuthion**
CAS Number		56-72-4	13194-48-4	2593-15-9	23135-22-0	34643-46-4
Chemical and Physical Parameters						
Soil Organic Carbon-Water Partitioning Coefficient (Koc)		3,660	213	163	10	7,470
Octanol/Water Partition Coefficient (Log Kow)		4.13	3.59	3.37	-0.48	5.67
Water Solubility (mg/L)		1.5	750	117	280,000	0.07
Henry's Law Constant (atm-m^3/mol)		3.10E-08	1.60E-07	2.80E-07	2.40E-10	3.01E-05
Vapor Pressure (mmHg)		9.70E-08	3.80E-04	1.00E-04	2.30E-04	9.40E-06
Environmental Fate Processes						
Soil	Mobility	Slight	Moderate	Moderate	Very High	None
	Expected to Volatilize	No	No	May from Moist Soil	No	May from Moist Soil
Water	Expected to Absorb into Suspended Solids and Sediment	Yes	No	No	No	Yes
	Expected to Volatilize	No	Yes	Yes	No	Yes
Air	Exist in Vapor Phase	No	Yes	Yes	Yes	Yes
	Exist in Particulate Phase	Yes	No	No	No	Yes

Source: (NOAA, 2016a)

EPA also compiled human health data for the five PAIs using the National Institute of Health National Library of Medicine Toxicology Data Network (TOXNET) database (HSDB, 2016). EPA compiled the carcinogenic and non-carcinogenic effects data available, summarized in Table 6-9. Human health data are available for the four registered PAIs, but not for Tokuthion (which is unregistered). Two of the four registered PAIs are probable carcinogens, and the other two may have serious respiratory, skin, eye, and nervous system human health effects.

Table 6-9. Human Health Effects of PAIs of Interest (per TOXNET)

	PAI Name				
	Coumaphos	**Ethoprop**	**Etridiazole**	**Oxamyl**	**Tokuthion[a]**
CAS Number	56-72-4	13194-48-4	2593-15-9	23135-22-0	34643-46-4
Carcinogenic Effects					
No Cancer Information					
Non-Carcinogenic	✓			✓	
Probable Carcinogen		✓	✓		
Non-Carcinogenic Effects					
Respiratory Problems	✓	✓		✓	
Skin Irritant	✓		✓	✓	
Eye Irritant	✓	✓	✓	✓	
Reproductive Problems					
Nervous System/Brain	✓			✓	
Nephrotoxic (Kidneys)					
Hepatotoxic (Liver)					
Circulatory/Heart				✓	
Nausea/Vomiting		✓		✓	
Convulsions	✓			✓	
Ataxia	✓				

Source: (HSDB, 2016)

[a] No human health data were provided in TOXNET.

6.3.6 Summary of EPA's Continued Targeted Review of PAIs Without Pesticide Chemicals Manufacturing Effluent Limitations

EPA's 2012 Annual Review identified 30 PAIs of interest for which there are no PAI-specific effluent limitations under Subpart A in 40 CFR Part 455. During the 1993 pesticides chemicals ELG revisions, EPA identified 29 of the 30 PAIs of interest, but did not establish PAI-specific nonconventional pollutant limitations. EPA's 2014 targeted review of the Pesticide Chemicals Category identified seven of the 30 PAIs that are currently registered or are under registration review in accordance with FIFRA Section 3.

During the current review, EPA reviewed data in PRISM and SSTS and identified five PAIs that are potentially manufactured in the U.S., one of which is unregistered, but produced in the U.S. for export as MUPs. At this time, EPA is not able to conclude that this is a comprehensive list due to the limitations of the datasets reviewed. However, for the five PAIs potentially manufactured in the U.S., EPA identified the following:

- All five PAIs have approved analytical methods that exist under the CWA.
- There are no current numeric PAI-specific effluent limitations for pesticide chemicals manufacturing (under Subpart A).

- One of the PAIs potentially manufactured in the U.S. has a reported pollutant load in the DMR database, originating from three POTWs; no PAI discharges were reported from pesticide chemicals manufacturing facilities. However, the Pesticide Chemicals ELGs do not establish PAI-specific numeric limitations for the PAIs; therefore, facilities may not be required to report discharges of the PAIs on their DMRs.
- Only one of the PAIs potentially manufactured in the U.S. is a TRI-listed chemical, and it does not have a pollutant load reported to TRI from any facility within the last five years. However, facilities are not required to report discharges for non-TRI-listed chemicals.
- Environmental fate data are available for all five PAIs. Human health effects data are available for all but one of the five PAIs (Tokuthion, which is produced in the U.S. for export).

6.3.7 Pesticide Chemicals Category References

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Appendix A: Evaluating Data Quality of Sources for the Effluent Guidelines Planning Review Report Supporting the Final 2016 Effluent Guidelines Program Plan

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Appendix A: Evaluating Data Quality Of Sources For The Effluent Guidelines Planning Review Report Supporting The Final 2016 Effluent Guidelines Program Plan

A.1 Background

For the current review, EPA continued preliminary category reviews of the Iron and Steel Manufacturing (40 CFR Part 420), Organic Chemicals, Plastics, and Synthetic Fibers (OCPSF) (40 CFR Part 414), and Pulp, Paper, and Paperboard (Pulp and Paper) (40 CFR Part 430) categories. For more information on these continued preliminary category reviews, see Section 4 of this report. Specifically, as part of its continued preliminary reviews of these categories, EPA:

- Reviewed historical documentation supporting the development of the effluent limitations guidelines and standards (ELGs).
- Evaluated available industrial wastewater discharge data, including discharge monitoring report (DMR) and Toxics Release Inventory (TRI) data.
- Contacted facilities to gather additional wastewater discharge data (including effluent concentrations) and to understand how process operations contribute to discharges.
- Contacted state permitting authorities to understand how they develop permit limits.
- Reviewed available National Pollutant Discharge Elimination System (NPDES) permit documentation for select facilities.
- Evaluated the performance of available treatment technologies for a subset of pollutants identified for further review.
- Reviewed data available in Canada's National Pollutant Release Inventory (NPRI) to identify potential additional pollutants that may be present in industrial wastewater discharges from these categories in the U.S.

EPA also continued its review of the Battery Manufacturing (40 CFR Part 461) and Electrical and Electronic Components (E&EC) (40 CFR Part 469) categories to further understand recent changes within the industries, and to identify potential new pollutants in industrial wastewater discharges that may not be adequately regulated by current ELGs. In addition, EPA reviewed miscellaneous food and beverage manufacturing sectors not currently regulated by national ELGs, to identify specific sectors that may require further review for the potential development of ELGs. For more information on these continued reviews, see Section 5 of this report. Specifically, for its reviews of Battery Manufacturing and E&EC, EPA:

- Reviewed historical documentation supporting the development of the ELGs.
- Evaluated available industrial wastewater discharge data, including DMR and TRI data.
- Reviewed available NPDES permit documentation for select facilities.
- Reviewed U.S. economic census data and other economic data (e.g., IBISWorld Industry Reports) to understand the status and current profile of the industry.

- Reviewed literature to gather information on current process operations, wastewater discharge practices, and treatment.
- Attended industry conferences and contacted industry trade associations and facilities to gather information on changes in the industry over time, and further understand current process operations, wastewater discharge practices, and treatment.

In addition, as part of the current review, EPA continued its review of several proposed actions identified in the *Final 2014 Effluent Guidelines Program Plan* (U.S. EPA, 2015), including (1) an investigation of the manufacture and processing of engineered nanomaterials (ENMs) as a potential new source of industrial wastewater discharge; (2) a review of industrial wastewater treatment technology data for inclusion in the Industrial Wastewater Treatment Technology (IWTT) Database; and (3) a targeted review of pesticide active ingredient (PAI) discharges not currently regulated under the Pesticide Chemicals ELGs (40 CFR Part 455). For more information on these reviews, see Section 6 of this report.

Specifically, for the investigation of the manufacture and processing of ENMs, EPA:

- Reviewed federal government publications on ENMs.
- Evaluated information obtained from the National Nanotechnology Initiative (NNI).
- Reviewed literature and attended industry conferences to gather information on ENM production, use, disposal, wastewater generation and treatment, analytical methods for ENM detection, and fate and transformation of ENMs in the environment.

For its review of industrial wastewater treatment technology data, EPA updated its continued review of industrial wastewater treatment technologies and the IWTT Database. The *Supplemental Quality Assurance and Control Plan for Development and Population of the Industrial Wastewater Treatment Technology Database* (ERG, 2013a) describes the IWTT data collection methods, data sources, data quality assurance and control criteria, and the plan for data storage. For this review, EPA attended and reviewed proceedings from technical conferences on wastewater treatment to gather additional information on wastewater treatment technology performance.

For its targeted review of PAI discharges that are not currently regulated under the Pesticide Chemicals ELGs, EPA:

- Reviewed historical documentation supporting the development of the Pesticide Chemicals ELGs.
- Reviewed Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) Section 3 and Section 7 data maintained by U.S. EPA Office of Pesticides Program.
- Reviewed other federal government and non-governmental organization databases regarding pesticide use, regulation, and toxicity.
- Evaluated available industrial wastewater discharge data, including DMR and TRI data.

For all of the analyses conducted as part of this review as described above, EPA collected data, evaluated their usefulness, and documented their usability and quality in accordance with the general specifications presented in the *Environmental Engineering Support for Clean Water Regulations Programmatic Quality Assurance Project Plan (PQAPP)* (ERG, 2013b).

EPA relied on TRI data and DMR data, downloaded from the Water Pollutant Loading Tool, as an integral component for most of the current review analyses. EPA documents the general quality assurance measures and criteria for DMR and TRI data in the *Revised Quality Assurance Project Plan for the 2009 Annual Screening-Level Analysis of TRI, ICIS-NPDES, and PCS Industrial Category Discharge Data* (ERG, 2009). EPA has documented the quality assurance measures and criteria of the Water Pollutant Loading Tool in Section 5 of the *Technical Users Background Document for the Discharge Monitoring Report (DMR) Pollutant Loading Tool* (U.S. EPA, 2012). Section 2.1 of this report describes in detail the methodology, utility, and limitations of the DMR and TRI data, as well as EPA's quality review, as they relate to the current review. Similarly, EPA relied on NPRI data to supplement the DMR and TRI data for a subset of its continued category reviews. Section 2.2 of this report describes in detail the methodology, utility, limitations of the NPRI data, as well as EPA's quality review as they relate to the current review.

The following sections provide more detailed information on EPA's evaluation of the data quality for all other data sources identified and used in this review.

A.2 Data Sources

EPA used the following categories of data sources for its current review:

- Conference proceedings, peer-reviewed journals, other academic literature.
- State and local government information provided in telephone calls and emails.
- Federal, state, and local government publications.
- Data and information obtained from industry and trade associations.
- Other (non-government, non-industry) publications and databases.

A.3 Data Quality Criteria

EPA used existing data to support analyses of the potential impact of industrial discharges on the environment. EPA obtained the existing data from government and other peer reviewed publications or databases, publicly available data, correspondence with industry and state and local governments, attending industry conferences, and online sources. EPA considered the accuracy, reliability, and representativeness of data sources to assess their usability for the current review, as described in Section 4.3.1 of the *Environmental Engineering Support for Clean Water Regulations PQAPP* (ERG, 2013b) and as expanded upon below. EPA also referenced Table 4-2 in the *Environmental Engineering Support for Clean Water Regulations PQAPP* to determine that the sources provided information that is sufficiently accurate and reliable for use in this review.

Accuracy. EPA assumed that the data and information contained in supporting government publications or databases, selected conference proceedings, peer-reviewed journal articles, and other academic literature are sufficiently accurate to support the general and/or facility-specific characterization of industries, process operations, and waste streams. EPA considered the data and information obtained from direct correspondence with state and local government representatives and regulators, and data from federal government agencies as sufficiently accurate to characterize and quantify specific wastewater discharges or process operations from individual facilities. EPA considered data from industry, including discussions with trade association and correspondence with individual facilities sufficiently accurate to provide a qualitative characterization and understanding of industries, process operations, and waste streams. EPA considered government and other economic data sources (e.g., U.S. economic census data, IBISWorld Reports) to be sufficiently accurate and used them in profiling industries and analyzing market statistics.

Reliability. EPA used the following criteria to evaluate the reliability of available data and other information collected and used in its analyses:

- The scientific work is clearly written, so that all assumptions and methodologies can be identified.
- The variability and uncertainty (quantitative and qualitative) of the information or in the procedures, measures, methods, or models are evaluated and characterized.
- The assumptions and methods are consistently applied throughout the analysis, as reported in the source.
- Waste streams, parameters, units, and detection limits (when appropriate) are clearly characterized.
- The governmental or facility contact is reputable and has knowledge of the industry, facility, process operation, or waste streams of interest.

EPA considered data sources that met these criteria sufficiently reliable to characterize and understand industries, process operations, and waste streams.

Representativeness. EPA used the following criteria to evaluate whether the data and information provide a national perspective and are relevant to and representative of the industry to which the data are applied:

- *Relevance*. The data source is relevant to the industry or pollutant group of interest (e.g., the industry description or Standard Industrial Classification (SIC) and North American Industry Classification System (NAICS) codes provided in the data source, when available, match the industry; the Chemical Abstract Service (CAS) number matches the CAS number for the pollutant or interest).

- *National applicability*. The data can be applied broadly to provide a national perspective relative to the industry or pollutant group of interest (e.g., the data are characteristic of the industry or pollutant group as a whole).

EPA considered data sources that met these criteria sufficiently representative to characterize industries, process operations, and waste streams.

A.4 Evaluating Data Quality

This section describes the data sources in more detail and how they met the evaluation criteria listed above. Table A-1 at the end of this section details the criteria applied and the conclusions reached on each data source.

A.4.1 Conference Proceedings, Peer-Reviewed Journal Articles, Other Academic Literature

EPA reviewed selected conference proceedings, peer-reviewed journal articles, and other academic literature in support of its reviews of Battery Manufacturing, E&EC, and ENMs. EPA applied the data quality criteria established in the *Environmental Engineering Support for Clean Water Regulations PQAPP* (ERG, 2013b) and determined that the data and information obtained from conference proceedings, peer-reviewed journals, and other academic literature were sufficiently accurate, reliable, and representative for process operations and waste streams associated with Battery Manufacturing, E&EC, and ENMs.

EPA is also collecting, reviewing, and compiling data on the performance of new or improved wastewater treatment technologies into a searchable IWTT Database. EPA obtained this industrial wastewater treatment technology data from conference proceedings, water-related journals, and literature from industry-specific organizations. For more information on EPA's efforts to ensure that the data sources included in the IWTT Database meet the data quality criteria, see the methodology documented in the *Supplemental Quality Assurance and Control Plan for the Development and Population of the Industrial Wastewater Treatment Technology Database* (ERG, 2013a).

A.4.2 State and Local Government Information Provided in Telephone Calls and Email Correspondence

In support of its continued reviews of the Iron and Steel, OCPSF, Battery Manufacturing and E&EC categories, EPA collected information through telephone calls and email correspondence with state and local government regulators and representatives regarding wastewater discharges from specific facilities. EPA considers information provided from such informal communications to be anecdotal, but useful for qualitative descriptions, such as general information on industrial sector trends, characterization of industrial wastewater discharges, and available industrial wastewater treatment technologies. From discussions with state and local government representatives, EPA often obtained published information such as NPDES permits and fact sheets; however, EPA evaluated the quality of this published information separately (see section A.4.3, Federal, State, and Local Government Publications, below).

A.4.3 Federal, State, and Local Government Publications

EPA reviewed federal, state, and local government publications related to its continued reviews of the Iron and Steel, OCPSF, Pulp and Paper, Battery Manufacturing and E&EC categories, and its targeted review of PAI discharges not currently regulated under the Pesticide Chemicals ELGs. These publications included regulations, U.S. Economic Census data, reports, government databases, and supporting documentation related to the specific industrial categories and pollutants of interest. EPA also reviewed state and local government publications, including NPDES permits and fact sheets. EPA used these publications to enhance its understanding of the impact of existing government programs and regulations on the industry or the pollutant group of interest. Using the criteria established in the *Environmental Engineering Support for Clean Water Regulations PQAPP* (ERG, 2013b), EPA determined that data and information provided in government publications are sufficiently accurate and reliable to characterize specific wastewater discharges, process operations, waste streams, and pollutant loads and concentrations, and/or could be applied nationally to characterize general industrial sector trends or pollutant groups of interest.

A.4.4 Industry and Trade Association Information

EPA obtained information from direct email or telephone communications with industry to support its continued reviews of the Iron and Steel, OCPSF, Pulp and Paper, Battery Manufacturing and E&EC categories. This included contacting specific facilities to obtain underlying concentration data used to calculate discharges reported to TRI as well as gathering information regarding facility-specific process operations and waste streams. EPA determined that data obtained directly from facility contacts regarding reported DMR or TRI data are sufficiently accurate, reliable, and representative to characterize the facility-specific wastewater discharges. EPA also obtained information from specific pulp and paper, battery manufacturing, and E&EC industry trade associations. This included descriptions of process operations, wastewater discharge practices, market statistics, potential pollutants of concern, wastewater characteristics, wastewater treatment technologies, and company profile information (e.g., types of products they produce). EPA applied the criteria established in the *Environmental Engineering Support for Clean Water Regulations PQAPP* (ERG, 2013b) and determined that this information was sufficiently accurate, reliable, and representative of the facilities of interest for use in characterizing industry sector trends and process operations that generate waste streams.

A.4.5 Non-Industry, Non-Government Publications and Databases

EPA obtained information (such as economic trends) from other non-industry, non-government publications (e.g., IBISWorld) and data from other non-governmental organizations (e.g., Pesticide Action Network Pesticide Database), in support of its reviews of the Battery Manufacturing, E&EC, and Pesticide Chemicals categories. EPA applied the criteria established in the *Environmental Engineering Support for Clean Water Regulations PQAPP* (ERG, 2013b) and determined that this information was sufficiently accurate, reliable, and representative for use in understanding and characterizing industrial sector trends.

A.5 References for Quality Assurance Activities Supporting the ELG Planning Review Report Supporting the Final 2016 ELG Plan

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2. ERG. 2013a. *Eastern Research Group, Inc. Supplemental Quality Assurance and Control Plan for the Development and Population of the Industrial Wastweater Treatment Technology Database.* Chantilly, VA. (November 22). EPA-HQ-OW-2010-0824-0263.

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4. U.S. EPA. 2012. *Technical Users Background Document for the Discharge Monitoring Report (DMR) Pollutant Loading Tool Version 1.0*. Washington, D.C. (January). http://cfpub.epa.gov/dmr/docs/Technical_Users_Background_Doc.pdf. EPA-HQ-OW-2014-0170-0203.

5. U.S. EPA. 2015. *Final 2014 Effluent Guidelines Program Plan*. Washington, D.C. (July). EPA-HQ-OW-2014-0170-0210.

Table A-1. Data Sources Supporting Analyses for EPA's Current Review

Data Source	Data Quality Criteria		Conclusions on Usability
	Accuracy and Reliability	Representativeness	
Conference Proceedings, Peer-Reviewed Journal Articles, Other Academic Literature	Information is obtained from selected national conference proceedings, peer-reviewed journal articles, and other academic literature. All data sources are clearly written, document methodologies and assumptions, describe variability and uncertainty (where relevant), and characterize waste streams, parameters, units, and detection limits.	Data and information are relevant to the industry or pollutant group to which the data are applied. Data also provide general information about industrial sector trends (e.g., new products and process operations). EPA determined this information could be applied nationally to the relevant sectors or pollutants of interest.	EPA considers this type of data and information sufficiently accurate, reliable, and representative, and therefore, usable to characterize industry operations, waste streams, wastewater discharge practices, and wastewater treatment performance.
State and Local Government Information Provided in Telephone Calls and Email Correspondence	State and local government representatives provided information on wastewater discharges from specific facilities through telephone calls and email correspondence. EPA considers the information anecdotal, but sufficiently accurate and reliable for qualitative descriptions. EPA requested published or written information to support information provided from informal communication, when available.	Data and information are relevant to the industry to which the data are applied. Though the information gathered from state and local government representatives was generally facility-specific (e.g., verification of facility wastewater discharge data and process operations), EPA determined that the information, when considered collectively, could be applied nationally to facilitate EPA's understanding of the category as a whole.	EPA considers this type of information anecdotal, but sufficiently accurate, reliable, and representative for characterizing facility-specific operations and discharges. EPA also considers this information useful for facilitating its understanding of category-wide industrial sector trends, wastewater discharges, and available wastewater treatment technologies. EPA evaluates the quality of any published documents from state or local governments separately (see Federal, State, and Local Government Publications, below).

Table A-1. Data Sources Supporting Analyses for EPA's Current Review

Data Source	Data Quality Criteria		Conclusions on Usability
	Accuracy and Reliability	**Representativeness**	
Federal, State, Local Government Publications	EPA assumes that all data provided in federal, state, or local government reports and regulations are sufficiently accurate and reliable. All reports, regulations, and supporting documentation are clearly written and document methodologies and assumptions.	EPA verified the representativeness of the data to the industrial sectors of interest using industry descriptions, or, when available, applicable SIC or NAICS codes provided in the supporting documentation. All federal government reports, regulations, and supporting documentation provide a national perspective related to the industry to which the data are applied. Though the information gathered from state and local government representatives was generally facility-specific (e.g., verification of facility wastewater discharge data and process operations), EPA determined that the information, when considered collectively, could be applied nationally to facilitate EPA's understanding of the category as a whole.	EPA considers this type of data sufficiently accurate, reliable, and representative, and therefore usable to support industry and waste stream characterization, and for estimating pollutant discharges.

Table A-1. Data Sources Supporting Analyses for EPA's Current Review

Data Source	Data Quality Criteria		Conclusions on Usability
	Accuracy and Reliability	**Representativeness**	
Industry and Trade Association Information	EPA considers information obtained from industry and trade associations to be less certain than peer-reviewed information; however, EPA determined this information was sufficiently accurate and reliable for characterizing industry trends and operations. All industry data and information was obtained from known industry sources (e.g., directly from facility contacts, from industry trade association, or from company websites). EPA considers information regarding reported DMR or TRI data obtained directly from facility contacts to be accurate and reliable for characterizing facility-specific wastewater discharges and estimating facility-specific discharges.	EPA verified the representativeness of the data to the industrial sectors of interest using industry descriptions, or, when available, applicable SIC or NAICS codes provided in the supporting documentation. Although much of the information obtained from industry was facility or company-specific, EPA determined it was representative of, and useful for, facilitating EPA's understanding of the category as a whole.	EPA considers this type of data sufficiently accurate, reliable, and representative, and therefore usable for characterizing industrial sector trends, process operations, and waste streams.
Other Non-Industry, Non-Government Publications and Databases	EPA considers information obtained from non-industry, non-government, non-peer reviewed sources (such as economic trends) to be less certain, but useful for the general industry. All non-industry information was obtained from known sources (e.g., IBISWorld, Pesticides Action Network).	EPA verified the representativeness of the data to the industrial sectors or pollutants of interest using industry descriptions, or, when available, applicable SIC or NAICS codes or CAS numbers provided in the supporting documentation.	Data are sufficiently accurate, reliable, and representative to use for generally characterizing industrial sector trends (new products or processes).

Appendix B:
Keyword Search Lists for Literature Reviews of Additional Point Source Categories

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Appendix B: Keyword Search Lists for Literature Reviews of Additional Point Source Categories

Keyword Search Terms for Battery Manufacturing Category Literature Review

Product Master Terms
Battery Manufacturing
Effluent
Process
Rechargeable
Wastewater
Discharge
Electric vehicle
Hybrid vehicle
Renewable Energy Storage
Microgrids
Small grids
SunShot Initiative Program (DOE)

Product Specific Terms
Anode
Cathode
Electrode
Lithium anode
Lithium ion
Lithium manganese oxide
Nickel-cadmium
Nickel-hydrogen
Nickel-metal hydroxide
Vanadium redox
(Electrochemical) Cell
Electrolyte
Terminals
Current Collector (support/grid)
Activator
Separator
Flow Battery

Process Master Terms
Fabrication
Production
Assembly
Wash/Washing/Rinsing
Ancillary operations
Curing
Amalgamation
Manufacture
Formulation
Casting
Rolling
Coating

Process Specific Terms
Wet air pollution control (wet scrubbers)
Paste Preparation
Electrolyte Oxidation
Equipment/floor/truck/laundry/personnel
Direct Chill Casting
Chemical reduction/oxidation
Closed/Open Formation
Plate Processing (Hydrosetting)
Plate Soaking
Wet/Dry Formation
Mold release
Counter current rinsing vs
single flowing rinse
Electrodeposition/Electrophoretic
deposition/electroplating

Keyword Search Terms for Electrical and Electronic Components

Category Literature Review

Master Terms
Electrical and electronic components
Industrial Wastewater
Industrial Wastewater Treatment
Metals Removal
Publicly owned treatment works (POTW)

General Terms
Effluent
Elimination
Influent
Percent (%)
Performance
Recovery/recycle
Reduce/reduction
Removal (efficiency)

Industry Operations
Cathode ray tube
Crystal wafers
Electronic crystals
- Piezoelectric crystals
- Lithium niobate
- Sapphire crystals
- Liquid crystals

Electronic devices
Luminescent Materials
Semiconductors
Solid state electrical devices

Process Operations and Products
Chemical Mechanical Planarization (CMP)
Sapphire Crystal Formation
- Czochralski Method
- Gradient Solidification
- Heat Exchanger Method
- Edge-Defined Film-Fed Growth (EFG)
- Kyropoulos Method
- Verneuil Flame-fusion Crystal Growth

Electron tube manufacturing
Gallium arsenic
Gallium phosphide wafers
Germanium wafers
Light emitting diode (LED)
Liquid crystal display device (LCD)
Polishing
- Nano diamonds
- Nanomaterials

Silicon based integrated circuits
Silicon wafers
Wafer diode
Wafer lapping
Wafer grinding
Hard drives
Lasers
Optical Applications
Silicon-on-sapphire microprocessors
Smartphone manufacturing
Sapphire boule
Solar cells

Appendix C:
Bibliography of Articles Entered into IWTT

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Table C-1. Bibliography of Articles Entered into IWTT to Date

Title	Document Type	Author(s)	Date	Journal or Publisher	Page Count	Industry
A Pilot Study of the Treatment of Waste Rolling Emulsion Using Zirconia Microfiltration Membranes	Peer-reviewed journal	Pei Wang, Nanping Xu, Jun Shi	2000	Journal of Membrane Science	8	Metal finishing
Nitrogen and DOC Removal from Wastewater Streams of the Metal-working Industry	Peer-reviewed journal	R. Schuch, R. Gensicke, K. Merkel, J. Winter	2000	Water Research	9	Metal finishing
Treatment of Rinsing Water from Electroless Nickel Plating with a Biologically Active Moving-bed Sand Filter	Peer-reviewed journal	T. Pumpel, C. Ebner, B. PernfuB, F. Schinner, L. Diels, Z. Keszthelyi, A. Stankovic, J.A. Finlay, L.E. Macaskie, M. Tsezos, H. Wouters	2001	Hydrometallurgy	11	Metal finishing
Optimization of Oily Wastewater Membrane Bioreactor Treatment: Pilot to Full Scale Results	Conference proceeding	Paul M. Sutton, Prakash N. Mishra, Jeff A. Roberts, Luis Abreu, Paul Gignac	2001	WEFTEC	24	Metal finishing
Reverse Osmosis Applied to Metal Finishing Wastewater	Peer-reviewed journal	Y. Benito, M.L. Ruiz	2002	Desalination	6	Ferroalloy manufacturing
A Pilot Study on a Membrane Process for the Treatment and Recycling of Spent Final Rinse Water from Electroless Plating	Peer-reviewed journal	F.S. Wong, J.J. Qin, M.N. Wai, A.L. Lim, M. Adiga	2002	Separation and Purification Technology	11	Metal finishing
Microsand Ballasted Flocculation and Clarification: Effects on Removal of TSS, Oil & Grease, and Metals from a Steel Mill Waste Stream	Conference proceeding	Carol Kessler, Luke Wood, Joe Gober, Barry Hendley	2002	WEFTEC	16	Iron and steel manufacturing
Heavy Metals Removal by Sand Filters Inoculated with Metal Sorbing and Precipitating Bacteria	Peer-reviewed journal	L. Diels, P.H. Spaans, S. Van Roy, L. Hooyberghs, A. Ryngaert, H. Wouters, E. Walter, J. Winters, L. Macaskie, J. Finlay, B. Pernfuss, H. Woebking, T. Pumpel, M. Tsezos	2003	Hydrometallurgy	7	Nonferrous metals manufacturing
Treatment of Oily Wastes by Membrane Biological Reactor	Conference proceeding	Jim Buckles, Art Kuljian, Kevin Olmstead, Jason Merritt	2003	WEFTEC	13	Metal finishing

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Title	Document Type	Author(s)	Date	Journal or Publisher	Page Count	Industry
NF and RO Membranes for the Recovery and Reuse of Water and Concentrated Metallic Salts from Waste Water Produced in the Electroplating Process	Peer-reviewed journal	Jasmine Castelblanque, Francesco Salimbeni	2004	Desalination	9	Metal finishing
A Pilot Study for Reclamation of a Combined Rinse from a Nickel-plating Operation Using a Dual-membrane UF/RO Process	Peer-reviewed journal	Jian-Jun Qin, Maung Nyunt Wai, Maung Htun Oo, Hsiaowan Lee	2004	Desalination	13	Metal finishing
Metal Recovery from Electroplating Wastewater Using Acidophilic Iron Oxidizing Bacteria: Pilot-Scale Feasibility Test	Peer-reviewed journal	Donghee Park, Dae Sung Lee, Jong Moon Park, Hee Dong Chun, Sung Kook Park, Ikuo Jitsuhara, Osamu Miki, Toshiaki Kato	2005	Industrial & Engineering Chemistry Research	6	Metal finishing
Physical/Chemical Treatment for Refinery Wastewater	Conference proceeding	William Conner, Mohammed Al Hajri, John Liu	2005	WEFTEC	25	Petroleum refining
The Use of Liquid-Liquid Extraction for Heavy Metals Recovery and Reuse from Plating Wastewaters	Conference proceeding	Paul Usinowicz, Bruce Monzyk, H. Nicholas Conkle, J. Kevin Rose, Satya Chauhan	2005	WEFTEC	11	Metal finishing
Pilot Study on the Treatment of Spent Solvent Cleaning Rinse in Metal Plating	Peer-reviewed journal	Jian-Jun Qin, Maung Htun Oo, Fook-Sin Wong	2006	Desalination	6	Metal finishing
Biologically produced sulphide for purification of process streams, effluent treatment and recovery of metals in the metal and mining industry	Peer-reviewed journal	Jacco L. Huisman, Gerard Schouten, Carl Schultz	2006	Hydrometallurgy	8	Ore mining and dressing
Electrochemical Treatment Applied to Food-Processing Industrial Wastewater	Peer-reviewed journal	Carlos Barrera-Diaz, Gabriela Roa-Morales, Liliana Avila-Cordoba, Thelma Pavon-Silva, Bryan Bilyeu	2006	Industrial & Engineering Chemistry Research	5	Non-classifiable establishments
Treatment of High-Strength Pharmaceutical Wastewater and Removal of Antibiotics in Anaerobic and Aerobic Biological Treatment Processes	Peer-reviewed journal	Ping Zhou, Chengyi Su, Binwei Li, Yi Qian	2006	Journal of Environmental Engineering	8	Pharmaceutical manufacturing
Copper Recovery and Spent Ammoniacal Etchant Regeneration Based on Hollow Fiber Supported Liquid Membrane Technology: From Bench-scale to Pilot-scale Tests	Peer-reviewed journal	Qian Yang, N.M. Kocherginsky	2006	Journal of Membrane Science	9	Metal finishing

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Title	Document Type	Author(s)	Date	Journal or Publisher	Page Count	Industry
Performance of an Up-flow Anaerobic Stage Reactor (UASR) in the Treatment of Pharmaceutical Wastewater Containing Macrolide Antibiotics	Peer-reviewed journal	Shreeshivadasan Chelliapan, Thomas Wilby, Paul J. Sallis	2006	Water Research	10	Pharmaceutical manufacturing
Three Years of Full-Scale Treatment of an Oily Wastewater Using an Immersed Membrane Biological Reactor	Industry publication	Jim Buckles, Art Kuljian, Kevin Olmstead, Tom Galloway	2007	WEFTEC	12	Transportation equipment cleaning
Application of struvite precipitation in treating ammonium nitrogen from semiconductor wastewater	Peer-reviewed journal	Hong-Duck Ryu, Daekeun Kim, Sang-Ill Lee	2008	Journal of Hazardous Materials	7	Electrical and electronic components
Twofold Solution	Industry publication	George Patrick, Don Deemer, Loren McCune, Terry Snell	2008	WEF Industrial Wastewater	5	Aluminum forming
Tough Treatment Technology Membrane Bioreactors Can Handle Wastewater with Very High Salt, Chloride, and Total Dissolved Solids Levels	Industry publication	Joseph Lala, Shannon R. Grant, and Scott J. Christian	2008	WEF Industrial Wastewater	6	Miscellaneous foods and beverages
No Spikes: Allowed Better Chemical Feed Controls Eliminate Unwanted Effluent Spikes	Industry publication	Allan Erickson	2008	WEF Industrial Wastewater	4	Meat and poultry products
Best Arsenic Technology: A Power-generating Facility Upgrades its Wastewater Treatment System to Meet Stricter Limits	Industry publication	Jean-Claude Younan, Joseph Chwirka	2008	WEF Industrial Wastewater	6	Steam electric power generating
Enhancing Nitrification in an Oil Refinery WWTP with IFAS	Conference proceeding	Wayne J. Flournoy, Russ Grillo, Sarah B. Hubbell, Ramesh Kalluri, Casey Mueller	2008	WEFTEC	9	Petroleum refining
Aquatic Toxicity Reduction and Water Reuse at a Metal Finishing Plant	Conference proceeding	George Patrick, Don Deemer, Loren McCune, Terry Snell	2008	WEFTEC	12	Aluminum forming
Footprint and O&M Cost Reductions with Actiflo System - A Pilot Study for Gold Mining Effluent Treatment	Conference proceeding	Zhifei Hu, Brian Edwards, Jes Alexant, Jamie Quesnel	2008	WEFTEC	10	Ore mining and dressing
Application of bioaugmentation to improve the activated sludge system into the contact oxidation system treating petrochemical wastewater	Peer-reviewed journal	Fang Ma, Jing-bo Guo, Li-jun Zhao, Chein-Chi Chang, Di Cui	2009	Bioresource Technology	6	Organic chemicals, plastics and synthetic fibers

Table C-1. Bibliography of Articles Entered into IWTT to Date

Title	Document Type	Author(s)	Date	Journal or Publisher	Page Count	Industry
Treatment of Beverage Production Wastewater by Membrane Bioreactor	Peer-reviewed journal	Marin Matošić, Ivana Prstec, Helena Korajlija Jakopović, Ivan Mijatović	2009	Desalination	9	Miscellaneous foods and beverages
Treatment of Textile Wastewater with an Anaerobic Fluidized Bed Reactor	Peer-reviewed journal	Mahdi Haroun, Azni Idris	2009	Desalination	10	Textile mills
Novel Single Stripper with Side-Draw to Remove Ammonia and Sour Gas Simultaneously for Coal-Gasification Wastewater Treatment and the Industrial Implementation	Peer-reviewed journal	Dachun Feng, Zhenjiang Yu, Yun Chen, Yu Qian	2009	Industrial & Engineering Chemistry Research	8	Oil and gas extraction
A Powerful Challenge: Treatment Plant Upgrade Aims to Minimize Electrical Conductivity While Nearly Doubling Capacity	Industry publication	James C. Young, Madan Arora, Lewis Nelson, and Richard Bono	2009	Industrial Wastewater	7	Non-classifiable establishments
Just Plane Better: Water Reuse Improves Aircraft Washing Operations at Texas Military Base	Industry publication	Richard Milhollon, Greg Braddy, Thomas Coffey, and Bill Morgan	2009	Industrial Wastewater	3	Airport deicing
Manage Water Better: Membrane Bioreactors Can Help Companies Make the Most of Their Water Resources	Industry publication	Jeff Peeters, Andrew Sparkes, Sven Baumgarten	2009	Industrial Wastewater	3	Grain mills
Manage Water Better: Membrane Bioreactors Can Help Companies Make the Most of Their Water Resources	Industry publication	Jeff Peeters, Andrew Sparkes, Sven Baumgarten	2009	Industrial Wastewater	3	Miscellaneous foods and beverages
Sludge Handling and Processing: A Taste for BOD5 Removal	Industry publication	Chandler Johnson, Neil McAdam	2009	Industrial WaterWorld	3	Miscellaneous foods and beverages
Transforming CBM Produced Water into a Valuable Resource	Industry publication	Juzer Jangbarwala	2009	Industrial WaterWorld	3	Oil and gas extraction
Selenium Removal from Refinery Wastewater via Iron Co-precipitation in a Mobile Clarifier	Conference proceeding	Charles McCloskey, Tom Jettinghoff	2009	Microconstituents /Industrial Water quality	7	Petroleum refining
Treatment of Metal Finishing Wastewater from Aircraft Maintenance Operations Using an Electrocoagulation Treatment Process	Conference proceeding	Forough Firouzi, Mark Ross, Gordon Champneys, Michael McFarland	2009	Microconstituents /Industrial Water Quality	8	Metal finishing

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Title	Document Type	Author(s)	Date	Journal or Publisher	Page Count	Industry
Too Many Causes	Industry publication	Naomi Jones, Adam Smith, Gang Xin	2009	WEF Industrial Wastewater	6	Non-classifiable establishments
Quenching the Thirst in China	Industry publication	Angela Yeung, Robert Chu, Steven Rosenberg, and Thomas Tong	2009	WEF Industrial Wastewater	5	Iron and steel manufacturing
Mix It Up: A Gas–energy Mixing System Helps Improve Moving-bed Biofilm Reactor Performance	Industry publication	Miroslav Colic, Wade Morse, Ariel Lechter, Jason Hicks, Steve Holley, Carl Mattia	2009	WEF Industrial Wastewater	7	Meat and poultry products
Easy Upgrade: A Membrane Bioreactor Enables a Meat Processor to Upgrade its Wastewater Treatment System with Little Fuss	Industry publication	Ralph Teckenberg, Sandra Schuler, Andreas Böhm, Torsten Hackner, Markus Roediger	2009	WEF Industrial Wastewater	4	Meat and poultry products
Two Fine Fluids: A Membrane Bioreactor Treats Winery Wastewater Effectively and Leaves More Room for Grapes	Industry publication	Anu Shah, John Bulleri, Richard Ross, John Carter, Michael Long	2009	WEF Industrial Wastewater	6	Miscellaneous foods and beverages
Liquid-Liquid Extraction for Acid Mine/Acid Rock Drainage Processing for Water Purification and Recovery of Sulfate Metals Without Sludge or Brine Production	Conference proceeding	Paul Usinowicz, Bruce Monzyk, H. Nicolas Conkle, F. Michael VonFahnestock, Todd Beers	2009	WEFTEC	16	Coal mining
Treatment of Metal Finishing Wastewaters in the Presence of Chelating Substances	Conference proceeding	Forough Firouzi, Mark Ross, Gordon Champneys, Michael McFarland	2009	WEFTEC	6	Metal finishing
Innovative Technology for Biological Nitrification-Denitrification of Oil Refinery Wastewaters	Conference proceeding	Carl E. Adams, Jr., Ryan Kirkland, John D. Driver, Andrew W. Edwards	2009	WEFTEC	20	Petroleum refining
Lessons Learned on Long-Term Operation of MBBR for Refinery Wastewater Treatment	Conference proceeding	Christian Cabral, Eoin Syron, Ray C. Asencio, Chandler Johnson	2009	WEFTEC	16	Petroleum refining

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Title	Document Type	Author(s)	Date	Journal or Publisher	Page Count	Industry
Pilot Testing and Modeling of a Membrane Biological Reactor System for Refinery Wastewater	Conference proceeding	Mauro Marinetti, Carlo Zaffaroni, Glen T. Daigger, Silas Givens, Ronald Ballard, C. P. Leslie Grady Jr., Savas Soydaner	2009	WEFTEC	20	Petroleum refining
Water Reuse in an Oil Refinery: An Innovative Solution Using Membrane Technology	Conference proceeding	Boris Ginzburg, Ross Cansino	2009	WEFTEC	11	Petroleum refining
Innovative Approaches to Complying with Very Low National Pollutant Discharge Elimination System (NPDES) Permit Limits for Metals	Conference proceeding	William Payne	2009	WEFTEC	13	Inorganic chemicals manufacturing
Innovative Approaches to Complying with Very Low National Pollutant Discharge Elimination System (NPDES) Permit Limits for Metals	Conference proceeding	William Payne	2009	WEFTEC	13	Non-classifiable establishments
Pilot-scale Removal of Chromium from Industrial Wastewater Using the ChromeBac System	Peer-reviewed journal	Wan Azlina Ahmad, Zainul Akmar Zakaria, Ali Reza Khasim, Muhamad Anuar Alias, Shaik Muhammad Hasbulla Shaik Ismail	2010	Bioresource Technology	8	Metal finishing
A Full-scale Biological Treatment System Application in the Treated Wastewater of Pharmaceutical Industrial Park	Peer-reviewed journal	Ge Lei, Hongqiang Ren, Lili Ding, Feifei Wang, Xingsong Zhang	2010	Bioresource Technology	10	Pharmaceutical manufacturing
TDS Removal in Wastewater Using Roughing Filters	Peer-reviewed journal	O I Nkwonta, G M Ochieng	2010	Chemical Sciences Journal	6	Coal mining
Process Development, Simulation, and Industrial Implementation of a New Coal-Gasification Wastewater Treatment Installation for Phenol and Ammonia Removal	Peer-reviewed journal	Zhenjiang Yu, Yun Chen, Dachun Feng, Yu Qian	2010	Industrial & Engineering Chemistry Research	8	Oil and gas extraction
What Nitrate?	Industry publication	Carl Adams Jr, Ryan Kirkland, John Driver, Andrew Edwards, Ruth Cade, Chad Louque, Wally Dows	2010	Industrial Wastewater	6	Petroleum refining

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Title	Document Type	Author(s)	Date	Journal or Publisher	Page Count	Industry
Ultrafiltration and RO Treatment Consolidates Water Treatment Process for Indian Refinery	Industry publication	Unknown	2010	Industrial Wastewater	2	Petroleum refining
Biological Treatment Helps Remove Nitrate, Sulfate from Mine Runoff	Industry publication	Mark Reinsel	2010	Industrial WaterWorld	2	Coal mining
Treatment System Extracts Value from Acid Mine Drainage	Industry publication	Unknown	2010	Industrial WaterWorld	1	Coal mining
Historic Mine Uses Ion Exchange for Copper, Cobalt Removal	Industry publication	Paul Egder, Adam Szczesniak, Mark Korzenecki	2010	Industrial WaterWorld	2	Ore mining and dressing
Zero Liquid Discharge Installation is the First Permit-Free Chromium Plating Operation	Industry publication	David Delasanta	2010	Industrial WaterWorld	2	Metal finishing
Turnkey Treatment System Tackles Food-Processing Wastewater	Industry publication	Unknown	2010	Industrial WaterWorld	2	Canned and preserved fruits and vegetables processing
Heavy metal removal from industrial effluents by sorption on cross-linked starch: Chemical study and impact on water toxicity	Peer-reviewed journal	Bertrand Sancey, Giuseppe Trunfio, Jérémie Charles, Jean-François Minary, Sophie Gavoille, Pierre-Marie Badot, Grégorio Crini	2010	Journal of Environmental Management	8	
Use of Ozone in a Pilot-Scale Plant for Textile Wastewater Pre-treatment: Physico-chemical Efficiency, Degradation By-products Identification and Environmental Toxicity of Treated Wastewater	Peer-reviewed journal	Cleder A. Somensi, Edésio L. Simionatto, Sávio L. Bertoli, Alberto Wisniewski Jr., Claudemir M. Radetski	2010	Journal of Hazardous Materials	6	Textile mills
Stripping Cleans Up: Research on the stripping performance of wastewater containing high-concentration ammonia-nitrogen and zinc from a refinery plant	Industry publication	Jiang Linshi, Li Wei, Ma Hongfei, Li Na	2010	Pollution Engineering	4	Petroleum refining
Wastewater Helps Run Your Car	Industry publication	Dr. Marcus Allhands	2010	Pollution Engineering	1	Organic chemicals, plastics and synthetic fibers

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Title	Document Type	Author(s)	Date	Journal or Publisher	Page Count	Industry
A Carbonless, Total Nitrogen Removal Process	Industry publication	Chandler Johnson	2010	Pollution Engineering	4	Non-classifiable establishments
Characterization and Treatment of Selenium in Water Discharged from Surface Coal Mining Operations in West Virginia	Conference proceeding	T. Harrison, T. Sandy, K. Leber, R. Srinivasan, J. McHale, J. Constant	2010	SME Annual Meeting	5	Coal mining
Suitable for Reuse	Industry publication	Elisângela Schneider, Ana Cláudia Figueiras Pedreira de Cerqueira, Geraldo Sant'Anna Jr., Marcia Dezotti	2010	WEF Industrial Wastewater	4	Petroleum refining
Needs More Work	Industry publication	Forough Firouzi, Mark A. Ross, Gordon Champneys, Michael J. McFarland	2010	WEF Industrial Wastewater	3	Metal finishing
Clear Results: Magnetic Ion Exchange Could Enable Pulp and Paper Mills to Reuse More Water.	Industry publication	Michael Bourke and Abigail Holmquist	2010	WEF Industrial Wastewater	4	Pulp, paper and paperboard
Food Wastes? No Problem! Full-scale Anaerobic Membrane Bioreactor Proves it Can Handle High-Strength Industrial Wastewater	Industry publication	Scott Christian, Shannon Grant, Dwain Wilson, Peter McCarthy, Dale Mills, Mike Kolakowski	2010	WEF Industrial Wastewater	4	Canned and preserved fruits and vegetables processing
High Strength? No Problem: Variable, High-strength Wastewater Not a Problem for Static Granular Bed Reactors	Industry publication	Jaeyoung Park, Michael F. Lally, Jin Hwan Oh, Timothy G. Ellis	2010	WEF Industrial Wastewater	7	Meat and poultry products
A Coordinated Approach to Achieving NPDES Permit Compliance for Mercury and Selenium in a Refinery Effluent	Conference proceeding	Greg Pulliam, Anthony Congram, Hal Davis, Bob Davis, Patricia Nelson	2010	WEFTEC	16	Petroleum refining
Evaluation of Activated Sludge Microfiltration for Refinery Wastewater Reuse	Conference proceeding	Christian Cabral, Erica Blumenschein, Carla Robinson	2010	WEFTEC	18	Petroleum refining
Wastewater Reuse Considerations at a Petroleum Refinery	Conference proceeding	Lucy Pugh, Alan Burghart, Carl Finlay	2010	WEFTEC	16	Petroleum refining
NPDES #WV1003763, Outlet #2 Selenium Treatment System Evaluation Report	Industry publication	Coal Mac, Inc.	2011	Consent Decree Report	3	Coal mining

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Title	Document Type	Author(s)	Date	Journal or Publisher	Page Count	Industry
Application of membrane technology on semiconductor wastewater reclamation: A pilot-scale study	Peer-reviewed journal	C.J. Huang, B.M. Yang, K.S. Chen, C.C. Chang, C.M. Kao	2011	Desalination	8	Electrical and electronic components
High Recovery Reverse Osmosis for Treatment of Produced Water	Industry publication	Bob Kimball, Ken Klinko	2011	Industrial WaterWorld	2	Oil and gas extraction
Desalinating Produced Water for Beneficial Re-Use	Industry publication	Lnsp Nagghappan	2011	Industrial WaterWorld	3	Oil and gas extraction
Sulfate Removal from Acid Mine Drainage for Potential Water Re-use	Conference proceeding	Alex West, David Kratochvil, Phil Fatula	2011	IWC	15	Mineral mining and processing
Sulfate Removal from Acid Mine Drainage for Potential Water Re-use	Conference proceeding	Alex West, David Kratochvil, Phil Fatula	2011	IWC	15	Ore mining and dressing
Absorbent Technology for Removal of Soluble Mercury at the Trace Contaminant Level (Low Part Per Trillion)	Conference proceeding	Gina Sacco, Cheryl Soltis-Muth	2011	IWC	10	Centralized waste treatment
Enzymatic Removal of Selenocyanate from Sour Water Stripper Bottoms	Conference proceeding	Greg DeLozier, Ph.D., Yakup Nurdogan, Ph.D., P.E.	2011	IWC	9	Petroleum refining
Case Study on Selenium Removal from a Combined FGD Wastewater and Landfill Leachate for a Power Plant on the Ohio River	Conference proceeding	Michael Soller, PE, CPC; James Harwood; Tim Pickett	2011	IWC	12	Steam electric power generating
Demonstration Test of Iron Addition to a Flue Gas Desulfurization (FGD) Absorber to Enhance Flue Gas Selenium Removal	Conference proceeding	Thomas E. Higgins, Karen Meade, Denis Fink	2011	IWC	14	Steam electric power generating
Evaluation of Carbon Sources for the Anaerobic Treatment of Flue Gas Desulfurization (FGD) Wastewaters for Heavy Metals Removal	Conference proceeding	Antonio O. Lau, Rudy Labban, Sunil Mehta, A. Paul Togna	2011	IWC	16	Steam electric power generating
Organic Removal with Granular Activated Carbon (GAC) from Distillate Water with Bio-Fouling Tendency, and associated issues: A Follow-up Report on a Power Plant Case-Study	Conference proceeding	Emmanuel Quagraine	2011	IWC	26	Steam electric power generating
In Search of the Highest Purity Ion Exchange Resin Available Stretching the Limit of Microelectronics	Conference proceeding	Alan Knapp, Slava Libman	2011	IWC	10	Electrical and electronic components

Table C-1. Bibliography of Articles Entered into IWTT to Date

Title	Document Type	Author(s)	Date	Journal or Publisher	Page Count	Industry
Anti-Fouling Membrane System for Industrial Wastewater Treatment and Recovery	Conference proceeding	Joon Min, Daeik Kim, Yong Eum, Gi T. Park, Sang W. Kim, Jang K. Kim, Dae H. Rhu	2011	IWC	11	Miscellaneous foods and beverages
Anti-Fouling Membrane System for Industrial Wastewater Treatment and Recovery	Conference proceeding	Joon Min, Daeik Kim, Yong Eum, Gi T. Park, Sang W. Kim, Jang K. Kim, Dae H. Rhu	2011	IWC	11	Oil and gas extraction
Anti-Fouling Membrane System for Industrial Wastewater Treatment and Recovery	Conference proceeding	Joon Min, Daeik Kim, Yong Eum, Gi T. Park, Sang W. Kim, Jang K. Kim, Dae H. Rhu	2011	IWC	11	Organic chemicals, plastics and synthetic fibers
Using Permeate Suction to Reduce Concentration Polarization in Spiral Wound Nanofiltration Module	Conference proceeding	Awad El-Shamy, Robert Carnahan, Mahmoud Nachabe, Mark Ross, Ayden Sunol, Ahmed Said	2011	IWC	11	Non-classifiable establishments
Recovery and Recycling of Industrial Side-stream Wastewater	Conference proceeding	Michael Chan	2011	IWC	6	Metal finishing
Ceramic Membranes: De-oiling and Produced Water Recovery, Operating Performance, Successes and Failures	Conference proceeding	R. Gay-de-Montella, Worley Parsons, T. Harding, V. Martez	2011	IWC	8	Oil and gas extraction
Piloting Conventional and Emerging Industrial Wastewater Treatment Technologies for the Treatment of Oil Sands Process Affected Water	Conference proceeding	Richard Mah, Rodney Guest, Pritesh Kotecha	2011	IWC	16	Oil and gas extraction
Concepts in Zero-Liquid Discharge	Conference proceeding	Christian, Melches; Matthias, Lowenberg; Gunter, Hofmann	2011	IWC	17	Steam electric power generating
Preliminary Assessment of a Thermal Zero Liquid Discharge Strategy for Coal-Fired Power Plants	Conference proceeding	H.A. Nebrig; Xinjun (Jason) Teng; David Downs	2011	IWC	13	Steam electric power generating
Solidification of FDG Wastewater with Fly Ash: Feasibility and Fate Analysis	Conference proceeding	Rudy Labban, Denise Horner, Mark Owens	2011	IWC	11	Steam electric power generating

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Title	Document Type	Author(s)	Date	Journal or Publisher	Page Count	Industry
The Use of Constructed Wetlands in the Treatment of Flue Gas Desulfurization Wastewater	Conference proceeding	Jared Morrison, Christopher Snider, Dennis Haag	2011	IWC	14	Steam electric power generating
Produced Water Softener Regeneration Using Boiler Blowdown	Conference proceeding	Francis Boodoo, Stephen Moylan	2011	IWC	9	Oil and gas extraction
A Review of the Cooling Water Methods for Sodium Hypochlorite Activation of Sodium Bromide into a Hypobromous Acid – Hypobromite Biocide	Conference proceeding	Liz Harrelson, Jonathan Howarth, Courtney Mesrobian, Todd Shaver	2011	IWC	10	Non-classifiable establishments
Chemical Treatment and Fill Selection Methods to Minimize Scaling/Fouling in Cooling Towers	Conference proceeding	Brad Buecker, Ray Post, Rich Aull	2011	IWC	10	Non-classifiable establishments
Hydrodynamic Cavitation for Cooling Water Treatment: A Technology Update	Conference proceeding	Philip Vella	2011	IWC	10	Miscellaneous foods and beverages
Generating 'Light Work' Removing Heavy Metals	Industry publication	Rob Aldave, Steven Buday	2011	Pollution Engineering	4	Steam electric power generating
Regenerative Turbine Aeration Technology	Industry publication	Stuart Ward	2011	Pollution Engineering	4	Non-classifiable establishments
Pilot Field-scale Demonstration of a Novel Alum Sludge-based Constructed Wetland System for Enhanced Wastewater Treatment	Peer-reviewed journal	Y.Q. Zhao, A.O. Babatunde, Y.S. Hu, J.L.G. Kumar, X.H. Zhao	2011	Process Biochemistry	6	Agricultural services
Enhancement of Start-up of Pilot-scale Granular SBR Fed with Real Wastewater	Peer-reviewed journal	Yong-Qiang Liu, Yunhua Kong, Joo-Hwa Tay, Jianrong Zhu	2011	Separation and Purification Technology	7	Non-classifiable establishments
Petroleum Refinery Stripped Sour Water Treatment Using the Activated Sludge Process	Peer-reviewed journal	Rion Merlo, Matthew Gerhardt, Fran Burlingham, Carla De Las Casas, Everett Gill, T. Houston Flippin	2011	Water Environment Research	12	Petroleum refining
Removal of Organics and Nutrients from Food Wastewater Using Combined Thermophilic Two-phase Anaerobic Digestion and Shortcut Biological Nitrogen Removal	Peer-reviewed journal	Fenghao Cui, Seungho Lee, Moonil Kim	2011	Water Research	8	Non-classifiable establishments

Table C-1. Bibliography of Articles Entered into IWTT to Date

Title	Document Type	Author(s)	Date	Journal or Publisher	Page Count	Industry
Purification of High Copper and TDS Acid Mine Drainage Water Using F-LLXTM AMD VEPTM Liquid-Liquid Extraction Technology	Conference proceeding	Paul J. Usinowicz, Bruce F. Monzyk, Ann E. Lane, Tenisha Highsmith, Niharika Chauhan	2011	WEFTEC	9	Ore mining and dressing
Selenium Treatment of Mine Water Effluent in a Fluidized Bed Reactor (FBR)	Conference proceeding	Kar Munirathinam, Rangesh Srinivasan, Jeff J. Tudini, Tom A. Sandy, Tim D. Harrison	2011	WEFTEC	21	Coal mining
Use of Dissolved Gas Flotation for Clarification of Biological Solids from a Petroleum Refinery Activated Sludge System	Conference proceeding	Brian Foy, Dr. Enos Stover, Charles C. Ross, J. Patrick Pierce	2011	WEFTEC	14	Petroleum refining
Process Design for Simultaneously Removing Arsenic and Manganese	Conference proceeding	H. C. Liang, Samuel J. Billin, Joseph R. Tamburini	2011	WEFTEC	6	Coal mining
Conceptual Design and Evaluation of Zero Liquid Discharge Systems for Management of Industrial Wastewater	Conference proceeding	Kristen Jenkins, Tom Higgins, Jim Mavis, Tom Sandy, Laura Reid, Ken Martins	2011	WEFTEC	10	Steam electric power generating
Process Optimization of a Petroleum Refinery Wastewater Treatment Facility Using Process modeling and Site Specific Biokinetic Constants	Conference proceeding	Hank Andres, David Kujawski, Oliver Schraa, Che-Jen Lin, Arthur Wong	2011	WEFTEC	15	Petroleum refining
Soluble and Total Aluminum after NaOH Neutralization of Acid Rock Discharges	Conference proceeding	Ronald Neufeld, Xunchi Pu, Oscar Martinez Vazquez	2011	WEFTEC	8	Coal mining
Steel Slag Filtration for Extensive Treatment of Mining Wastewater	Conference proceeding	Dominique Claveau-Mallet, Scott Wallace, Yves Comeau	2011	WEFTEC	14	Coal mining
Use of Softening-Enhanced High Density Sludge Treatment to Recover Mine Water for Beneficial Irrigation Reuse	Conference proceeding	Jim Stefanoff, Darby Stacey, James Almaas, Greg Pulliam, Karen Meade	2011	WEFTEC	9	Ore mining and dressing
Framework for a Mixed-Culture Biofilm Model to Describe Oxidized Nitrogen, Sulfur, and Selenium Removal in a Biofilm Reactor	Conference proceeding	Joshua P. Boltz, Doris Brockmann, Thomas Sandy, Bruce R. Johnson, Glen T. Daigger, Kristen Jenkins, Kar Manirathinam	2011	WEFTEC	12	Non-classifiable establishments

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Title	Document Type	Author(s)	Date	Journal or Publisher	Page Count	Industry
Activated Anaerobic Digestion with a Membrane Filtration System	Conference proceeding	S. Joh Kang, Kevin Olmstead, Oliver Schraa, Dai Hwan Rhu, Young Jin Em, Jang Kyu Kim, Joon H. Min,	2011	WEFTEC	19	CAFO
Chemical Treatment for Nitrite Nitrogen Removal from Stainless Steel Pickling Liquor Wastewater	Conference proceeding	Ryan A. Kirkland, A. Todd Lusk, Dr. Meint Olthof, David G. Gilles	2011	WEFTEC	7	Iron and steel manufacturing
Coal Seam Gas Water Treatment and Reuse Options	Conference proceeding	Graeme R. Lewis, Peter Baudish	2011	WEFTEC	16	Oil and gas extraction
Membranes for Wastewater Reclamation and Reuse for Petrochemical and Petroleum Refining Industries	Conference proceeding	Joseph Wong	2011	WEFTEC	12	Petroleum refining
Industrial Waste Waters Re-use: Application of 3FM High Speed Filtration and High Rate Softening as Pre-Treatment of Wastewaters from the High Water Consuming Pulp & Paper Sector	Conference proceeding	Marie-Pierre Denieul, Stephanie Mauchauffee, Eric Barbier, Gilles Le Calvez, Aurore De Laval, Marielle Coste	2011	WEFTEC	15	Pulp, paper and paperboard
Treatment of Acrylic Acid Production Wastewater Using a Submerged Anaerobic Membrane Bioreactor	Conference proceeding	Michael Allison, Kripa Singh, Jonathan Webb, Shannon Grant	2011	WEFTEC	11	Organic chemicals, plastics and synthetic fibers
Uranium (VI) Reduction Under Facultative Anaerobic Conditions	Conference proceeding	Simphiwe Chabalala, Evans M. N. Chirwa	2011	WEFTEC	9	Ore mining and dressing
Extreme Water Reuse: Recycling in a Food Products Industry	Conference proceeding	Nicholas B. Cooper, Tracy Barker, A.G. Fishbeck	2011	WEFTEC	8	Wholesale trade - durable goods
Pretreatment of Electronics Wastewater for Reuse: Removal of Calcium Using Controlled Hydrodynamic Cavitation	Conference proceeding	Sunjip Kim, Jin-Young Park, Yong-Woo Lee, Jae-Jin Lee, Yun-Kyu Choi, Kyu-Won Hwang, Philip Vella, Won-Kwon Lee	2011	WEFTEC	16	Electrical and electronic components

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Title	Document Type	Author(s)	Date	Journal or Publisher	Page Count	Industry
Nitrification performance and microbial ecology of nitrifying bacteria in a full-scale membrane bioreactor treating TFT-LCD wastewater	Peer-reviewed journal	Liang-Ming Whang, Yi-Ju Wu, Ya-Chin Lee, Hong-Wei Chen, Toshikazu Fukushima, Ming-Yu Chang, Sheng-Shung Cheng, Shu-Fu Hsu, Cheng-Huey Chang, Wason Shen, Chung Kai Huang, Ryan Fu, Barkley Chang	2012	Bioresource Technology	8	Metal finishing
A Simultaneous Removal of Beryllium and Ammonium–nitrogen from Smelting Wastewater in Bench- and Pilot-scale Biological Aerated Filter	Peer-reviewed journal	Fang Sun, Wei-Ling Sun	2012	Chemical Engineering Journal	8	Nonferrous metals manufacturing
Hospital Wastewater Treatment by Membrane Bioreactor: Performance and Efficiency for Organic Micropollutant Elimination	Peer-reviewed journal	Lubomira Kovalova, Hansruedi Siegrist, Heinz Singer, Anita Wittmer, Christa S. McArdell	2012	Environmental Science & Technology	10	Hospital
Biosorption and Recovery of Chromium from Industrial Wastewaters by Using Saccharomyces cerevisiae in a Flow-Through System	Peer-reviewed journal	Giovanni Colica, Pier Cesare Mecarozzi, Roberto De Philippis	2012	Industrial & Engineering Chemistry Research	6	Metal finishing
Removal of Cr(VI) and Humic Acid by Heterogeneous Photocatalysis in a Laboratory Reactor and a Pilot Reactor	Peer-reviewed journal	Lucía d. C. Cid, María d. C. Grande, Eduardo O. Acosta, Berta Ginzberg	2012	Industrial & Engineering Chemistry Research	7	Non-classifiable establishments
Use of Constructed Wetland Systems with Arundo and Sarcocornia for Polishing High Salinity Tannery Wastewater	Peer-reviewed journal	Cristina S.C. Calheiros, Paula V.B. Quitério, Gabriela Silva, Luís F.C. Crispim, Hans Brix, Sandra C. Moura, Paula M.L. Castro	2012	Journal of Environmental Management	6	Leather tanning and finishing
Study of Permeate Flux in Micellar-enhanced Ultrafiltration on a Semi-Pilot Scale: Simultaneous Removal of Heavy Metals from Phosphorous Rich Real Wastewaters	Peer-reviewed journal	Piia Hayrynen, Junkal Landaburu-Aguirre, Eva Pongracz, Riitta L. Keiski	2012	Separation and Purification Technology	8	Fertilizer manufacturing
Selenium Treatment in Refinery Wastewater	Conference proceeding	Sudini Padmasiri, Ronald Olivacce, Charles Meyer	2012	WEFTEC	13	Petroleum refining

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Title	Document Type	Author(s)	Date	Journal or Publisher	Page Count	Industry
Removal of Selenium in Refinery Effluent with Adsorption Media	Conference proceeding	Missy Hayes, Nancy Sherwood	2012	WEFTEC	12	Petroleum refining
Fate and Effect of Naphthenic Acids on Biological Wastewater Treatment Systems in Oil Refineries	Conference proceeding	Spyros G. Pavlostathis, Teresa Misiti, Ulas Tezel, Madan Tandukar	2012	WEFTEC	10	Petroleum refining
Breakpoint Chlorination of Petroleum Refinery WWTP Effluent	Conference proceeding	Carla L. De Las Casas, Matthew B. Gerhardt, Rion P. Merlo, T. Houston Flippin, Fran B. Burlingham, David S. Murray	2012	WEFTEC	14	Petroleum refining
Selenium Removal from Oil Refinery Wastewater Using Advanced Biological Metal Removal (ABMet®) Process	Conference proceeding	Yakup Nurdogan, Patrick Evans, Jill Sonstegard	2012	WEFTEC	13	Petroleum refining
Acid Mine Drain (AMD) Treatment to Achieve Very Low Residual Heavy Metal Concentrations	Conference proceeding	Miroslav Colic, Jack Hogan	2012	WEFTEC	23	Ore mining and dressing
Water Chemistry Considerations for Improving Molybdenum Removal at a Mine Water Treatment Facility	Conference proceeding	H. C. Liang, Glenn Wright, Joseph R. Tamburini, W. Brinson Willis	2012	WEFTEC	6	Ore mining and dressing
Remote High-Altitude Pilot Treatment System for Mining-Impacted Waters	Conference proceeding	Christina Progess, Ram Ramaswami, John DeAngelis, Tom Rutkowski	2012	WEFTEC	4	Ore mining and dressing
Pilot Testing of Selenium Removal in a Surface Coal Mine Water Containing High Nitrate and Selenium Concentrations	Conference proceeding	Matthew Gay, Rangesh Srinivasan, Kar Munirathinamm, Tom A. Sandy	2012	WEFTEC	18	Coal mining
Bench- and Pilot-Scale Testing of Ion Exchange and Zero Valent Iron Technologies for Selenium Removal from a Surface Coal Mine Run-Off Water	Conference proceeding	Ken Martins, Jeremy Johnson, Karen Leber, Rangesh Srinivasan, Bo Heller	2012	WEFTEC	21	Coal mining
Treatment of Fatty Wastewater from Food and Beverage Processing Industries	Conference proceeding	Markus Roediger, Ralph Teckenberg, Alexander Ghazinuri	2012	WEFTEC	9	Dairy products processing

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Treatment of Fatty Wastewater from Food and Beverage Processing Industries	Conference proceeding	Markus Roediger, Ralph Teckenberg, Alexander Ghazinuri	2012	WEFTEC	9	Meat and poultry products
Dissolved Air Flotation as Secondary Clarification	Conference proceeding	Houston Flippin, Larry Cuomo and Lynn Petersen	2012	WEFTEC	6	Dairy products processing
Industrial Water Treatment and Resource Recovery Using Anti-Fouling Membrane System for Brewery Wastewater	Conference proceeding	Joon H. Min, Young J. Eum, Charles Wardle, Allen Chen, Jarod Limke, Gi T. Park, Sang U. Kim, Jang K. Kim, Dae H. Rhu	2012	WEFTEC	8	Miscellaneous foods and beverages
Management of Soluble Organics in Produced and Flowback Waters with Swellable, Absorbent Glass	Conference proceeding	Paul Edmiston, Justin Keener, Shawn McKee, Scott Buckwald, Gregory Hallahan, Michael Grossman	2012	WEFTEC	14	Oil and gas extraction
MBR for Wastewater Recycling in Textile Industry the Experiences of an Operator from Idea to Implementation	Conference proceeding	R. Teckenberg, T. Pohlers, A. Ghazinuri, M.Hoffmeister, S. Schuler	2012	WEFTEC	8	Textile mills
Evaluation of PEG Biodegradability Using MBR and MBBR	Conference proceeding	Daniel B. Wilkinson, Katie L. Jones, Angela J. Walsh, Laura R. Crisman	2012	WEFTEC	11	Pharmaceutical manufacturing
MBBR to MBR – Unique Process Configuration for Pharmaceutical Wastewater Treatment/Reuse	Conference proceeding	Katie L. Jones, Daniel B. Wilkinson, Angela J. Walsh, Laura R. Crisman	2012	WEFTEC	12	Pharmaceutical manufacturing
Comparison of COD and Toxicity Removal during Activated Sludge and MBBR Treatment of Kraft Pulp Mill Effluent	Conference proceeding	Natália R. de Rezende, Ann H. Mounteer, Geovana C. Mozer, Eduarda O. Reis	2012	WEFTEC	11	Pulp, paper and paperboard
Fluidized Bed Bioreactor Technology: Implementation and Operation for Industrial Contaminated Water Treatment	Conference proceeding	Todd S. Webster, Dave Enegess, Sam Frisch	2012	WEFTEC	12	Centralized waste treatment
Fluidized Bed Bioreactor Technology: Implementation and Operation for Industrial Contaminated Water Treatment	Conference proceeding	Todd S. Webster, Dave Enegess, Sam Frisch	2012	WEFTEC	12	Coal mining

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Fluidized Bed Bioreactor Technology: Implementation and Operation for Industrial Contaminated Water Treatment	Conference proceeding	Todd S. Webster, Dave Enegess, Sam Frisch	2012	WEFTEC	12	Inorganic chemicals manufacturing
Fluidized Bed Bioreactor Technology: Implementation and Operation for Industrial Contaminated Water Treatment	Conference proceeding	Todd S. Webster, Dave Enegess, Sam Frisch	2012	WEFTEC	12	Petroleum refining
Pilot Study of Pulp & Paper Mill Effluent Treatment with MBR-RO System	Conference proceeding	Vetrivel Dhagumudi, Dr. Dongxu Yan	2012	WEFTEC	13	Pulp, paper and paperboard
Development of a Site Specific Toxicity-based Operating Guideline for Nitrite Nitrogen in a Petroleum Refinery Wastewater Discharge	Conference proceeding	David W. Johnston, Scott M. Anderson, David R. Marrs	2012	WEFTEC	11	Petroleum refining
Use of High-Pressure CO2 for Concentrating CrVI from Electroplating Wastewater by Mg−Al Layered Double Hydroxide	Peer-reviewed journal	Xiangying Lv, Zhi Chen, Yongjing Wang, Feng Huang, Zhang Lin	2013	Applied Materials and Interfaces	5	Metal finishing
Optimization of Continuous Reactor at Pilot Scale for Olive-oil mill wastewater treatment by Fenton-like process	Peer-reviewed journal	Gassan Hodaifa, J.M. Ochando-Pulido, S. Rodriguez-Vives, A. Martinez-Ferez	2013	Chemical Engineering Journal	8	Miscellaneous foods and beverages
Treatment of Copper Wastewater Using Optimal Current Electrochemical–Coagulation	Peer-reviewed journal	Kyungtae Kim, Fenghao Cui, Hyunsik Yoon, Moonil Kim	2013	Environmental Technology	8	Electrical and electronic components
Complete Removal of Organic Contaminants from Hypersaline Wastewater by the Integrated Process of Powdered Activated Carbon Adsorption and Thermal Fenton Oxidation	Peer-reviewed journal	Weijun Zhang, Xiaoyin Yang, Dongsheng Wang	2013	Industrial & Engineering Chemistry Research	7	Organic chemicals, plastics and synthetic fibers
Nitrification Performance in a Membrane Bioreactor Treating Industrial Wastewater	Peer-reviewed journal	Lukas Dvorak, Jan Svojitka, Jiri Wanner, Thomas Wintgens	2013	Water Research	10	Non-classifiable establishments
Electrocoagulation: Performance in Treatment of Slop Water and Other Wastewaters	Conference proceeding	Alena Tetreault-Haarstad, Peter Dold, Tore Oian	2013	WEFTEC	17	Oil and gas extraction
Design and Performance of the First Full Scale Membrane Bioreactor Plant Treating Oil Refinery Effluent in Brazil	Conference proceeding	Ana Claudia Cerqueira, Tiago Lopes, Vania Santiago, Marcus Vallero, Joubert Trovati, Brian Arntsen, Wajahat Syed	2013	WEFTEC	12	Petroleum refining

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Title	Document Type	Author(s)	Date	Journal or Publisher	Page Count	Industry
Treatment of Refinery Wastewater Containing High Concentrations of Chemical Oxygen Demand and Total Sulfides for Low Odor Processing through a Capacity-Challenged Bioreactor	Conference proceeding	Rich Clasen, Stan Heimburger, Mike Fagan, Mostafa Jahanian	2013	WEFTEC	13	Petroleum refining
Selenium Removal from a Refinery Wastewater: Integrated Approach from Source Control to Wastewater Treatment	Conference proceeding	Marinetti Mauro, Ciongoli Bernardino, Zaffaroni Carlo, Munirathinam Kar	2013	WEFTEC	18	Petroleum refining
EcoRight MBR Pilot Study Investigating Treatability of a Saudi Aramco Refinery Wastewater	Conference proceeding	William Cunningham, Chad Felch, Duane Smith, Thomas Vollstedt	2013	WEFTEC	21	Petroleum refining
Fracking Wastewater Treatment at Collection Facility	Conference proceeding	Miroslav Colic, Ray Guthrie, Ariel Lechter	2013	WEFTEC	13	Oil and gas extraction
Selenium Recovery for Beneficial Reuse from Zinc Smelting Processing at Low pH conditions	Conference proceeding	Jang K. Kim, Joon H. Min, Young Jin Eum, Eui J. Yang, Myeong J. Yu, Jungwoo Lee	2013	WEFTEC	11	Nonferrous metals manufacturing
MBR Based Treatment of Tractor Manufacturing Wastewater	Conference proceeding	Miroslav Colic, Ray Guthrie, Ariel Lechter	2013	WEFTEC	20	Metal finishing
Coke Oven Wastewater Treatment Using on Immersed Membrane Biological Reactor	Conference proceeding	Art Kuljian, Jr, Ben Mutton, Greg Shamitko	2013	WEFTEC	21	Petroleum refining
Optimization of the Alternate Cycling Process for Nutrient Removal in Industrial Wastewater Treatment Plants – Full Scale Study	Conference proceeding	Mónica de Gracia, Asun Larrea, and Malcolm Fabiyi	2013	WEFTEC	11	Transportation equipment cleaning
Activated Sludge Operation in the Extreme Conditions of MLSS, TDS, and Temperature	Conference proceeding	Jurek Patoczka, John Scheri	2013	WEFTEC	13	Iron and steel manufacturing
Activated Sludge Operation in the Extreme Conditions of MLSS, TDS, and Temperature	Conference proceeding	Jurek Patoczka, John Scheri	2013	WEFTEC	13	Landfills
Activated Sludge Operation in the Extreme Conditions of MLSS, TDS, and Temperature	Conference proceeding	Jurek Patoczka, John Scheri	2013	WEFTEC	13	Pharmaceutical manufacturing
Effect of Oxic Conditions On the Performance of Membrane Bioreactor Systems – Pilot and Full Scale Evaluations	Conference proceeding	Karen Connery, Malcolm Fabiyi, Asun Larrea	2013	WEFTEC	11	Pharmaceutical manufacturing

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Effect of Oxic Conditions On the Performance of Membrane Bioreactor Systems – Pilot and Full Scale Evaluations	Conference proceeding	Karen Connery, Malcolm Fabiyi, Asun Larrea	2013	WEFTEC	11	Textile mills
DAF Optimization: Production Increases Require Engineering and Automation to Achieve Operational Excellence and Continuous Improvement Goals	Conference proceeding	G. Swearingen, S. Dusenbery, C Scott-Woodfork, M Bradley, C. Bartz, J. Gideon	2013	WEFTEC	15	Petroleum refining
Development and Implementation of a Novel Sulfur Removal Process from H2S Containing Wastewaters	Conference proceeding	Glenn T. Diagger, Andrew Hodgkinson, Simon Aqualina, Kim Fries	2013	WEFTEC	13	Pulp, paper and paperboard
Full Scale Application of Ozone for Bulking Control at a Pulp & Paper Facility	Conference proceeding	Asun Larrea, Andoni Urruticoechea, Malcolm Fabiyi	2013	WEFTEC 2013	10	Pulp, paper and paperboard
Removal of Active Pharmaceutical Ingredients (APIs) from Wastewater - a review of existing treatment solutions	Conference proceeding	Achim Ried, Edward G. Helmig, Greg Claffey, Keel Robinson, Matthew J. DeMarco	2014	WEFTEC	16	Hospital
Removal of Active Pharmaceutical Ingredients (APIs) from Wastewater - a review of existing treatment solutions	Conference proceeding	Achim Ried, Edward G. Helmig, Greg Claffey, Keel Robinson, Matthew J. DeMarco	2014	WEFTEC	16	Pharmaceutical manufacturing
Start Up and Commissioning of a Membrane Bioreactor Plant Treating a High TDS Refinery Wastewater	Conference proceeding	Mauro Marinetti, Kar Munirathinam, Bernardino Ciongoli, Carlo Zaffaroni, Ali Redha	2014	WEFTEC	16	Petroleum refining
A Combined Biological and Advanced Oxidation Process for the Treatment of Wastewaters from the Microelectronics Industry.	Conference proceeding	Sunil Mehta, Nabin Chowdhury, Denise Horner, Antonio Lau, Barbara Schilling	2014	WEFTEC	11	Electrical and electronic components
Use of DSS-MBR-PACT Process to Improve Nitrification and AOX Removal in the Treatment of Herbicides Production Wastewater	Conference proceeding	Liron Shoshani, Chaim Sheindorf, Asher Brenner	2014	WEFTEC	17	Pesticide chemicals
One Automotive Manufacturer: Three Membrane Applications for Wastewater Pretreatment and Reuse	Conference proceeding	Lucy Pugh, Joan Gautier, Eric Van Orman, Cullum Pakosh, Duane Dehner	2014	WEFTEC	27	Aluminum forming

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Title	Document Type	Author(s)	Date	Journal or Publisher	Page Count	Industry
One Automotive Manufacturer: Three Membrane Applications for Wastewater Pretreatment and Reuse	Conference proceeding	Lucy Pugh, Joan Gautier, Eric Van Orman, Cullum Pakosh, Duane Dehner	2014	WEFTEC	27	Metal finishing
Long Term Operation of Moving Bed Biofilm Reactor for Nitrification of a Refinery Effluent at Elevated Temperatures	Conference proceeding	R. Branco, E. Lannegrace, R. Lafond, C. Dale	2014	WEFTEC 2014	8	Petroleum refining
Phosphorous Removal from Industrial Wastewater Using Dissolved Air Flotation to Meet Discharge Requirements for the Chesapeake Bay Watershed	Conference proceeding	Charles C. Ross, J. Patrick Pierce, G. Edward Valentine	2014	WEFTEC 2014	14	Meat and poultry products
Flue Gas Desulfurization (FGD) Wastewater Best Available Technology Economically Achievable (BAT), 2015 Steam Electric Effluent Limitation Guidelines and Standards Rulemaking.	Government report	U.S. EPA Office of Water	2015		490	Steam electric power generating
Flue Gas Desulfurization (FGD) Wastewater Pretreatment Standards for New Sources (PSNS), 2015 Steam Electric Effluent Limitation Guidelines and Standards Rulemaking.	Government report	U.S. EPA Office of Water	2015		490	Steam electric power generating
Flue Gas Desulfurization (FGD) Wastewater Chemical Precipitation Treatment, 2015 Steam Electric Effluent Limitation Guidelines and Standards Rulemaking.	Government report	U.S. EPA Office of Water	2015		490	Steam electric power generating
Biological Treatment of Coke Plant Wastewater with Activated Sludge MBR Technology	Conference proceeding	Art Kuljian, Jeff Penny, Joshua Harrison	2015	WEFTEC	19	Iron and steel manufacturing
Mercury Removal from Coke Plant Waste Water: Process Design and Operational Optimization	Conference proceeding	Frank Jere, Joe Clute	2015	WEFTEC	6	Iron and steel manufacturing
Strong Enough? Piloting Aerobic vs. Anaerobic Treatment for Food and Beverage Wastewater	Conference proceeding	David Riedel, Octavio Casvantes, Jay Kulowiec	2015	WEFTEC	15	Canned and preserved fruits and vegetables processing
Model-based evaluation for the upgrade of an industrial wastewater treatment plant to enhanced biological phosphorus removal (EBPR)	Conference proceeding	Guclu Insel, Ozlem Ketenci, Gulsum Zengin, Emine Cokgor, Peter Dold	2015	WEFTEC	14	Textile mills

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Title	Document Type	Author(s)	Date	Journal or Publisher	Page Count	Industry
Treatment of High-Strength Industrial Solvent Waste	Conference proceeding	Emil Schultz, Brad Carter, Ralph Schultz	2015	WEFTEC	9	Non-classifiable establishments
Characterization and treatability of mercury in a petroleum refinery wastewater discharge	Conference proceeding	K Sky Bellanca, David R Marrs	2015	WEFTEC	12	Petroleum refining

Appendix D:
Treatment Technology Performance Data in IWTT by Pollutant

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Table D-1. Pollutants with Performance Data in IWTT

Pollutant[a]	Number of Treatment Systems[b]
Acetic acid, 2-bromo-2-chloro	1
Acids, volatile fatty (as acetic acid)	1
Active Pharmaceutical Ingredients (APIs)	1
Adsorbable organic halides (AOX)	1
Alkalinity	1
Alkalinity (as CaCO3)	4
Alkalinity, bicarbonate (as CaCO3)	1
Alkalinity, total (as CaCO3)	2
Aluminum	3
Aluminum, total	5
Ammonia	5
Ammonia (as N)	17
Ammonia (as NH3)	10
Ammonia (as NH4)	4
Ammonia, total	6
Ammonia, total (as N)	3
Ammonia-nitrogen	6
Ammonium, nonvolatile	1
Ammonium, volatile	1
Ammonium-nitrogen	10
Ammonium-nitrogen (NH4-N)	3
Ampicillin	1
Antimony, total	3
Arsenic	7
Arsenic, total	3
Arsenic, total (as As)	1
Azithromycin	1
Barium	2
Barium, total	4
Benzene	2
Benzo(a)pyrene	2
Beryllium	1
Beryllium, total	3
Bisoprolol	1
BOD	27
BOD, carbonaceous, 05 day, 20 C	1
BOD, soluble	1
BOD, total	5
BOD5	12
Boron	3

Table D-1. Pollutants with Performance Data in IWTT

Pollutant[a]	Number of Treatment Systems[b]
Boron, total	3
BTEX	4
Cadmium	11
Cadmium, total	3
Calcium	8
Calcium, total	3
Carbamazepine	1
Carbon dioxide (as CO2)	2
Carbon, dissolved organic (as C)	3
Carbon, tot organic (TOC)	18
Chemical oxygen demand	60
Chemical oxygen demand, dissolved	1
Chemical oxygen demand, soluble	6
Chemical oxygen demand, total	16
Chloride	12
Chloride, total	3
Chlorinated VOCs	1
Chlorine	1
Chlorine, total residual	1
Chloroform	1
Chlortetracycline (Aureomycin)	1
Chromium	10
Chromium, hexavalent	8
Chromium, total	7
Ciprofloxacin	2
Cobalt	1
Cobalt, total	3
Color (Pt-Co units)	2
Color, concentration at wavelength	4
Conductivity	12
Copper	11
Copper, total	7
Cyanide	4
Cyanide, total	4
Cyanide, total (as CN)	2
Cyanide, weak acid, dissociable	1
Dibromoacetic acid (DBAA)	1
Dichloromethane	1
Diclofenac	1
Dissolved oxygen (DO)	6

Table D-1. Pollutants with Performance Data in IWTT

Pollutant[a]	Number of Treatment Systems[b]
Estrogenicity, 17-beta estradiol equivalent	1
Ethylbenzene	2
Ethylene glycol	1
Fats, oils and grease (FOG)	9
Fats, oils and grease, total (TFOG)	2
Fluoride	3
Haloacetic acids (HAA5)	1
Hardness (as CaCO3)	2
Hardness, Ca calculated (mg/L as CaCO3)	1
Hardness, Mg calculated (mg/L as CaCO3)	1
Hardness, total (as CaCO3)	1
Hydrogen sulfide	3
Iron	7
Iron, total	8
Lead	5
Lead, total	5
Magnesium	5
Magnesium, total	3
Manganese	4
Manganese, total	6
Mercury	6
Mercury, dissolved (as Hg)	1
Mercury, particulate	1
Mercury, total	4
Metronidazol	1
Molybdenum, total	3
Morphine	1
Naphthalene	2
Naphthenic acid	5
Nickel	13
Nickel, total	4
Nitrate	5
Nitrate (as N)	11
Nitrate (as NO3)	2
Nitrate/Nitrite as N	1
Nitrite (as N)	6
Nitrite (as NO2)	2
Nitrite plus nitrate (as N)	3
Nitrite Plus Nitrate Total	1
Nitrogen, inorganic total	1

Table D-1. Pollutants with Performance Data in IWTT

Pollutant[a]	Number of Treatment Systems[b]
Nitrogen, Kjeldahl total (TKN)	19
Nitrogen, Kjeldahl total (TKN) filtered	1
Nitrogen, organic	1
Nitrogen, total	14
Nitrogen, total (as N)	1
N-Methyl-2-pyrrolidone	1
n-Propylbenzene	1
Oil	2
Oil and grease	12
Oil and grease, hexane extr method	4
Oil and grease, SGT-HEM	1
Oil and grease, total	1
ORP	2
Oxygen demand, chem. (COD), dissolved	2
Oxygen demand, total	2
Perchlorate (ClO4)	1
Phenol	8
Phenol, nonvolatile	1
Phenol, volatile	1
Phenolic compounds, total	1
Phenols	5
Phosphate	3
Phosphate (as P)	3
Phosphate, ortho (as P)	1
Phosphate, total (as PO4)	1
Phosphorus	5
Phosphorus, total	23
Phosphorus, total (as P)	3
Phosphorus, total filtered	1
Selenate (VI)	2
Selenite (IV)	2
Selenium	6
Selenium, dissolved	3
Selenium, dissolved 0.45 um filter	1
Selenium, total	13
Silica, dissolved (as SiO2)	1
Silica, total (as SiO2)	2
Silicate (SiO4-2 as SiO2)	1
Silver	3
Silver, total	3

Table D-1. Pollutants with Performance Data in IWTT

Pollutant[a]	Number of Treatment Systems[b]
Sodium	5
Sodium, total	3
Sodium, total (as Na)	1
Solids, total	3
Solids, total dissolved (TDS)	26
Solids, total suspended (TSS)	7
Solids, total volatile	2
Solids, volatile suspended	7
Strontium, total (as Sr)	1
Sulfate	9
Sulfate (as S)	1
Sulfate (as SO4)	1
Sulfate, total	3
Sulfate, total (as SO4)	1
Sulfide	4
Surfactants	1
Suspended solids	4
Tetramethyl ammonium hydroxide	2
Thallium, total	3
Thiocyanate	3
Thiocyanate (filtered)	1
Tin	2
Tin, total	3
Titanium, total	3
Toluene	2
Total petroleum hydrocarbons	2
Total phenols	1
Total suspended solids	42
Trichloroacetic acid (TCAA)	1
Turbidity	9
Vanadium	1
Vanadium, total	3
Xylene	2
Zinc	10
Zinc, total	5

a Pollutant names are only as specific as the names stated in each article.

b A treatment system may target more than one pollutant. Additionally, the number of treatment systems is based on review of the articles collected as part of the literature review, presented in Appendix C.

Message

From:	Flanders, Phillip [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=0CB247EF96F642F98CB727A9ED48E49E-FLANDERS, P]
Sent:	12/18/2017 5:44:26 PM
To:	Whitlock, Steve [Whitlock.Steve@epa.gov]; Kimberly Bartell [Kimberly.Bartell@erg.com]
CC:	Kim Wagoner [Kim.Wagoner@erg.com]; Elizabeth Gentile [elizabeth.gentile@erg.com]
Subject:	RE: Draft Email to Regions for MPP and Pulp

I'm fine with the draft email, except that you don't need to say "EPA EAD" just "EAD" suffices.

I'm out starting at 12:00 tomorrow.

From: Whitlock, Steve
Sent: Monday, December 18, 2017 12:39 PM
To: Kimberly Bartell <Kimberly.Bartell@erg.com>; Flanders, Phillip <Flanders.Phillip@epa.gov>
Cc: Kim Wagoner <Kim.Wagoner@erg.com>; Elizabeth Gentile <elizabeth.gentile@erg.com>
Subject: RE: Draft Email to Regions for MPP and Pulp

Kim,
I received your email and I think it looks good. I haven't been able to discuss with Phillip yet.
I'll check Phillip's schedule to see if he will be in this week and let you know.
--Steve--

From: Kimberly Bartell [mailto:Kimberly.Bartell@erg.com]
Sent: Monday, December 18, 2017 12:04 PM
To: Flanders, Phillip <Flanders.Phillip@epa.gov>; Whitlock, Steve <Whitlock.Steve@epa.gov>
Cc: Kim Wagoner <Kim.Wagoner@erg.com>; Elizabeth Gentile <elizabeth.gentile@erg.com>
Subject: RE: Draft Email to Regions for MPP and Pulp

Phillip and Steve,

I wanted to confirm you received my email below last week. Please let me know if there are any changes before we move forward contacting the regions.

Thank you,
Kim

From: Kimberly Bartell
Sent: Thursday, December 14, 2017 11:23 AM
To: Flanders, Phillip <Flanders.Phillip@epa.gov>; 'Whitlock, Steve' <Whitlock.Steve@epa.gov>
Cc: Kim Wagoner <Kim.Wagoner@erg.com>; Elizabeth Gentile <Elizabeth.Gentile@erg.com>
Subject: Draft Email to Regions for MPP and Pulp

Phillip and Steve,

We drafted the email below to send to EPA regions for the meat and poultry and pulp and paper reviews. We plan to email the NPDES region contacts for Regions 1, 3, and 4 to request to set up a call to discuss nutrient discharges from meat and poultry and pulp and paper facilities. Please review the email below and let us know if you have any edits or comments before we send them out.

Thank you!

Kim

Dear Contact Name:

Eastern Research Group, Inc. (ERG), a contractor for EPA Office of Water (OW), Engineering and Analysis Division (EAD), is e-mailing you to request information on meat and poultry and pulp and paper facilities in your region. See below for further background.

Specifically, ERG is working with Phillip Flanders and Steve Whitlock of EPA's EAD to conduct its annual review of the existing effluent limitations guidelines, as required by the Clean Water Act. The purpose of the annual review is to gather information on current discharges from various industry categories to determine whether or not revisions to or development of effluent guidelines may be appropriate. EPA EAD will discuss this review and the results in its Preliminary 2018 Effluent Guidelines Program Plan, scheduled for publication in the Federal Register in 2018 (see https://www.epa.gov/eg for further information).

To support the review of existing effluent guidelines, we are gathering information on nutrient discharges from meat and poultry and pulp and paper facilities. We would like to discuss nutrient discharges from these industries as well as request copies of NPDES permits and fact sheets for a few facilities. Please let us know your availability to set up a short call to discuss this information.

If you have any questions in the meantime, please call me at (517) 515-1721. If you would like to speak directly with EAD regarding this request, you can contact Steve Whitlock by phone at (202) 566-1541 or by email: whitlock.steve@epa.gov.

Thank you,
Kim

Message

From: Flanders, Phillip [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=0CB247EF96F642F98CB727A9ED48E49E-FLANDERS, P]
Sent: 2/13/2018 2:39:08 PM
To: Kim Wagoner [Kim.Wagoner@erg.com]
Subject: RE: 304m weekly calls

Can you add Tony Tripp to these meetings? He's now the second alt-WACOR and should be on the list. I suspect he'll want to attend these after E&EC ramps up again.

From: Kim Wagoner [mailto:Kim.Wagoner@erg.com]
Sent: Tuesday, February 13, 2018 9:11 AM
To: Flanders, Phillip <Flanders.Phillip@epa.gov>; Whitlock, Steve <Whitlock.Steve@epa.gov>; Born, Tom <Born.Tom@epa.gov>; Deborah Bartram <deborah.bartram@erg.com>; Elizabeth Gentile <elizabeth.gentile@erg.com>; Kimberly Bartell <Kimberly.Bartell@erg.com>
Subject: RE: 304m weekly calls

Good morning! Attached is the updated punch list. In addition for the agenda we have:

- Final 2016 Plan and Review Report
  - Deliberative Process / Ex. 5
- Preliminary 2018 Plan and Review Report
  - Deliberative Process / Ex. 5
- Pilot technology review – Deliberative Process / Ex. 5 Deliberative Process / Ex. 5
- IWTT
  - Deliberative Process / Ex. 5
- EJ
- HELGA
- Generic ICR
  - Deliberative Process / Ex. 5
- EGIS
  - Deliberative Process / Ex. 5
- Kick-off meetings/calls
  - Deliberative Process / Ex. 5

Anything else?

Kim Wagoner, P.E.

Environmental Engineer
ERG
14555 Avion Parkway Suite 200
Chantilly, VA 20151
703-633-1620

-----Original Appointment-----
From: Kim Wagoner
Sent: Wednesday, May 17, 2017 12:44 PM
To: Kim Wagoner; Flanders, Phillip; Whitlock.steve@Epa.gov; Born, Tom; Deborah Bartram; Elizabeth Gentile; Kimberly Bartell
Subject: 304m weekly calls
When: Tuesday, February 13, 2018 10:00 AM-11:00 AM (UTC-05:00) Eastern Time (US & Canada).
Where: Via conference call: [redacted]

Phillip will be out of the office next Wednesday so we are going to reschedule our weekly call for Tuesday. Hopefully this time works for everyone!

****
All, we have to make a change to our call-in information for our weekly calls. Please note the new number below.

Call I[redacted]
Code[redacted]

Message

From: Flanders, Phillip [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=0CB247EF96F642F98CB727A9ED48E49E-FLANDERS, P]
Sent: 12/6/2017 5:10:05 PM
To: Hessenauer, Meghan [Hessenauer.Meghan@epa.gov]
Subject: FW: ERG Proprietary: Work Plan and Cost Estimate EPA Contract No. EP-C-17-041, WA 0-05
Attachments: EP-C-17-041 Work Plan_WA 0-05.pdf

Meghan,

I recommend that this Work Plan be approved.

Phillip Flanders

From: Teresa Medley [mailto:Teresa.Medley@erg.com]
Sent: Wednesday, November 08, 2017 3:42 PM
To: Hessenauer, Meghan <Hessenauer.Meghan@epa.gov>; Born, Tom <Born.Tom@epa.gov>; Flanders, Phillip <Flanders.Phillip@epa.gov>; Whitlock, Steve <Whitlock.Steve@epa.gov>; Heath, Brad <Heath.Brad@epa.gov>
Cc: Deborah Bartram <deborah.bartram@erg.com>; Lori Weiss <Lori.Weiss@erg.com>; Kim Wagoner <Kim.Wagoner@erg.com>; Leigh Roller <Leigh.Roller@erg.com>; Irene Johnson <Irene.Johnson@erg.com>; Teresa Medley <Teresa.Medley@erg.com>
Subject: ERG Proprietary: Work Plan and Cost Estimate EPA Contract No. EP-C-17-041, WA 0-05

ATTENTION: Information contained in this document is ERG privileged and confidential. The contents of this material shall not be duplicated, used, or disclosed in whole or in part without the permission of Eastern Research Group, Inc.

To All,

The attached file contains the work plan and cost estimate for the above referenced work assignment. Please let me know if you have any questions.

The work plan and cost estimate has been uploaded onto FEDCONNECT.

Regards,

Teresa A. Medley
Eastern Research Group Inc. (ERG)
(703) 633-1655 (Office)
(703) 263-7280 (Fax)
teresa.medley@erg.com
ERG

-----Original Message-----
From: notifier@fedconnect.net [mailto:notifier@fedconnect.net]
Sent: Wednesday, November 08, 2017 3:38 PM
To: Teresa Medley <Teresa.Medley@erg.com>
Subject: Your Work Plan was received by ENVIRONMENTAL PROTECTION AGENCY/CINCINNATI PROCUREMENT OPERATIONS DIVISION today, 11/8/2017 3:35:00 PM.

Title: Evaluating Industrial Discharges Reference Number: 0-05 For more information, please log into FedConnect at https://www.fedconnect.net/fedconnect, click on the Awards page and click on the Award corresponding to the Title above.

This message is sent to you as a courtesy because you are a member of the Work Plan Team for this opportunity. If you wish to be removed from future emails about this Award, please remove your name from the Work Plan Team at https://www.fedconnect.net/fedconnect

Please do not reply to this email.

If you need help with FedConnect, please contact support@fedconnect.net.

Message

From: Flanders, Phillip [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=0CB247EF96F642F98CB727A9ED48E49E-FLANDERS, P]
Sent: 4/24/2018 9:09:11 PM
To: Kimberly Bartell [Kimberly.Bartell@erg.com]
CC: Kim Wagoner [Kim.Wagoner@erg.com]
Subject: RE: Draft Docket User Guide for the Final 2016 Plan
Attachments: Final 2016 Plan User Guide_042018_pmf.docx

Very minor comments on this one.

From: Kimberly Bartell [mailto:Kimberly.Bartell@erg.com]
Sent: Friday, April 20, 2018 9:12 AM
To: Flanders, Phillip <Flanders.Phillip@epa.gov>
Cc: Kim Wagoner <Kim.Wagoner@erg.com>
Subject: Draft Docket User Guide for the Final 2016 Plan

Hi Phillip:

Attached, please find a draft of the docket user guide for the Final 2016 Plan. There are a few comments for you in the document and we will update the final FDMS numbers throughout after the docket is published. This document and the record index will be finalized a few days after publication.

Let us know if you have any comments or questions.

Thanks,
Kim

Kim Bartell
Environmental Engineer
Eastern Research Group, Inc.
517-515-1721

Appointment

From: Flanders, Phillip [/o=ExchangeLabs/ou=Exchange Administrative Group (FYDIBOHF23SPDLT)/cn=Recipients/cn=0cb247ef96f642f98cb727a9ed48e49e-Flanders, P]
Sent: 9/5/2018 6:25:38 PM
To: Lidgard, Michael [Lidgard.Michael@epa.gov]; Smith, DavidW [Smith.DavidW@epa.gov]; Zhang, Qian [Zhang.Qian@epa.gov]; Dunn, John [Dunn.John@epa.gov]; Baskin, Kilty [Baskin.Kilty@epa.gov]; Schweizer, Jonathan [schweizer.jonathan@epa.gov]; Jones, Erica [Jones.Erica@epa.gov]; Trulear, Brian [Trulear.Brian@epa.gov]; Obrien, Karen [obrien.karen@epa.gov]; Pimpare, Justin [Pimpare.Justin@epa.gov]; Chadwick, Dan [Chadwick.Dan@epa.gov]; Wen, Chen [Wen.Chen@epa.gov]; Roberts, Cindy [Roberts.Cindy@epa.gov]; Livnat, Alexander [Livnat.Alexander@epa.gov]; Swanson, Nicholas [Swanson.Nicholas@epa.gov]; Schillo, Bruce [Schillo.Bruce@epa.gov]; Kazior, Kathryn [Kazior.Kathryn@epa.gov]; Pickrel, Jan [Pickrel.Jan@epa.gov]
CC: Green, Margaret [green.margaret@epa.gov]; Shuart, Ryan [shuart.ryan@epa.gov]; R6 6WQ-PO [R6_6WQPO@epa.gov]; Hamilton, Denise [hamilton.denise@epa.gov]

Subject: Prelim ELG Plan 14 OS
Attachments: PrelimPlan14 Briefing_082118.docx
Location: Conf Call: Conference Line/Code / Ex. 6

Start: 9/5/2018 7:00:00 PM
End: 9/5/2018 8:00:00 PM
Show Time As: Tentative

Conference Line/Code / Ex. 6

ELG Planning Workgroup Members,

Thank you for your continued dedication to this project. We had our Options Selections meeting with the OW AA (Dave Ross) today (8/22). I would like to keep you all informed about what we are discussing, so I will give the same briefing to you that the AA received. I will also discuss some initial reactions and, if I receive decisions by the time of the call, I will communicate those as well. The briefing covered the suggested content of the next Preliminary ELG Program Plan. Please note that we are simplifying the names of the Plans by using numbers instead of years: this is Preliminary Plan 14. (The Final 2016 Plan was the 13th final plan that we have published. 13 plans in 28 years – not too bad!)

Also, please let me know if the workgroup representative for your office or region has changed.

Thank you,

Phillip Flanders, Ph.D., P.E.

Environmental Engineer
Engineering and Analysis Division
Office of Science and Technology
Office of Water

EPA United States Environmental Protection Agency

Mail Code 4303T
(202) 566-8323
www.epa.gov/eg

Message

From: Flanders, Phillip [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=0CB247EF96F642F98CB727A9ED48E49E-FLANDERS, P]
Sent: 4/18/2018 2:59:31 PM
To: Whitlock, Steve [Whitlock.Steve@epa.gov]
Subject: RE: 304m weekly calls

Thanks for letting us know.

From: Whitlock, Steve
Sent: Wednesday, April 18, 2018 10:56 AM
To: Kim Wagoner <Kim.Wagoner@erg.com>; Deborah Bartram <deborah.bartram@erg.com>; Flanders, Phillip <Flanders.Phillip@epa.gov>; Born, Tom <Born.Tom@epa.gov>; Elizabeth Gentile <elizabeth.gentile@erg.com>; Kimberly Bartell <Kimberly.Bartell@erg.com>; Cuff, Jalyse <cuff.jalyse@epa.gov>; Tripp, Anthony <Tripp.Anthony@epa.gov>
Subject: RE: 304m weekly calls

I won't be on the call today—I have a training class.
--Steve--

From: Kim Wagoner [mailto:Kim.Wagoner@erg.com]
Sent: Wednesday, April 18, 2018 10:45 AM
To: Deborah Bartram <deborah.bartram@erg.com>; Flanders, Phillip <Flanders.Phillip@epa.gov>; Whitlock, Steve <Whitlock.Steve@epa.gov>; Born, Tom <Born.Tom@epa.gov>; Elizabeth Gentile <elizabeth.gentile@erg.com>; Kimberly Bartell <Kimberly.Bartell@erg.com>; Cuff, Jalyse <cuff.jalyse@epa.gov>; Tripp, Anthony <Tripp.Anthony@epa.gov>
Subject: RE: 304m weekly calls

Good morning! Attached is the updated punch list. In addition for the agenda we have:

- Final 2016 Plan and Review Report
  - Deliberative Process / Ex. 5
- Preliminary 2018 Plan and Review Report
  - Deliberative Process / Ex. 5
- IWTT
  - Deliberative Process / Ex. 5
- HELGA
  - Deliberative Process / Ex. 5
- Generic ICR
  - Deliberative Process / Ex. 5
- EGIS
  - Deliberative Process / Ex. 5

- Cost tool/Pilot technology review
  - Deliberative Process / Ex. 5
- E&EC Study
  - Deliberative Process / Ex. 5
- Environmental issues analysis

Anything else?

Kim Wagoner, P.E.
Environmental Engineer
ERG
14555 Avion Parkway Suite 200
Chantilly, VA 20151
703-633-1620

-----Original Appointment-----
From: Kim Wagoner
Sent: Wednesday, May 17, 2017 12:44 PM
To: Kim Wagoner; Deborah Bartram; Flanders, Phillip; Whitlock.steve@Epa.gov; Born, Tom; Elizabeth Gentile; Kimberly Bartell; cuff.jalyse@epa.gov; Tripp, Anthony
Subject: 304m weekly calls
When: Wednesday, April 18, 2018 11:00 AM-12:00 PM (UTC-05:00) Eastern Time (US & Canada).
Where: Via conference call [redacted]

All, we have to make a change to our call-in information for our weekly calls. Please note the new number below.

Call In [redacted]
Code: [redacted]

Message

From: Flanders, Phillip [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=0CB247EF96F642F98CB727A9ED48E49E-FLANDERS, P]
Sent: 5/16/2018 1:57:02 PM
To: Strassler, Eric [Strassler.Eric@epa.gov]
Subject: FW: Final 2016 Plan Docket Users Guide & Record Index
Attachments: Final 2016 Plan User Guide_508.pdf; Final 2016 Plan Record Index_Final.pdf

Docket User Guide attached.

From: Kimberly Bartell [mailto:Kimberly.Bartell@erg.com]
Sent: Monday, May 14, 2018 2:37 PM
To: Flanders, Phillip <Flanders.Phillip@epa.gov>
Cc: Kim Wagoner <Kim.Wagoner@erg.com>; Teresa Medley <Teresa.Medley@erg.com>
Subject: Final 2016 Plan Docket Users Guide & Record Index

Hi Phillip,

Attached, please find the 508 version of the docket users guide for the Final 2016 Plan along with the record index.

Please let us know if you have any questions.

Thanks!
Kim

User Guide Index for EPA-HQ-OW-2015-0665 - 2016 Final Plan

RECORD SECTION	EPA DOCUMENT ID	TITLE	ABSTRACT	DOCUMENT TYPE	AUTHOR	AUTHOR DATE	SOURCE CITATION	CATEGORY INDUSTRY	PAGE	CBI	COPY-RIGHTED	DCN
10.15	EPA-HQ-OW-2015-0665-0330	Telephone Communication with Sean Aldrich, Intel Corporation, and Anna Dimling, ERG, Re: Intel Corporation in Chandler, AZ - DCN 08334	Telephone conversation between Sean Aldrich, Intel Corporation, and Anna Dimling, Eastern Research Group, Inc. , about Intel Corporation in Chandler, AZ.	Meeting Materials	Aldrich, Sean	04/05/2016	Aldrich, Sean. 2016. Telephone Communication Between Sean Aldrich, Intel Corporation, and Anna Dimling, ERG, Re: Intel Corporation. (April 5).	Electrical and Electronic Components	3	No	No	08334
10.15	EPA-HQ-OW-2015-0665-0331	Novel Process for the Treatment of Wastewaters from the Microelectronics Industry - DCN 08335	Infilco Degremont, Inc. has developed an innovative process to treat wastewaters generated by the microelectronics industry, paper presented at the International Water Conference.	Publication	Ballard, T., et al.	05/01/2013	Ballard, T., et al. 2013. Novel Process for the Treatment of Wastewaters from the Microelectronics Industry. IWC. (May).	Electrical and Electronic Components	8	No	No	08335
10.15	EPA-HQ-OW-2015-0665-0332	Summary of Semiconductor Presentations and Posters at 2016 ASMC SEMI Conference, Saratoga Springs, NY - DCN 08336	Memorandum from Anna Dimling, ERG, to Jezebele Alicea, U.S. EPA, regarding the Summary of Semiconductor Presentations and Posters at 2016 ASMC SEMI Conference, Saratoga Springs, NY.	Memorandum	ERG	06/13/2016	ERG. 2016. Memorandum from Anna Dimling, ERG, to Jezebele Alicea, U.S. EPA. Re: Summary of 2016 ASMC SEMI Conference. Chantilly, VA. (June 13).	Electrical and Electronic Components	6	No	No	08336

RECORD SECTION	EPA DOCUMENT ID	TITLE	ABSTRACT	DOCUMENT TYPE	AUTHOR	AUTHOR DATE	SOURCE CITATION	CATEGORY INDUSTRY	PAGE	CBI	COPY - RIGHTED	DCN
10.15	EPA-HQ-OW-2015-0665-0333	Notes from the July 7, 2016 Meeting with the Semiconductor Industry Association (SIA) - DCN 08337	Meeting notes from the July 7, 2016 with the Semiconductor Industry Association, EPA, and ERG.	Meeting Materials	ERG	07/07/2016	ERG. 2016. Notes from Meeting with the Semiconductor Industry Association (SIA). Chantilly, VA. (July).	Electrical and Electronic Components	41	No	No	08337
10.15	EPA-HQ-OW-2015-0665-0334	Process Development and Optimization for High-Aspect Ration Through-Silicon Via (TSV) Etch - DCN 08338	This paper presents the challenges encountered in developing the 6µm x 55µm TSV (6µm diameter x 55µm depth) with a number of continuous process optimizations.	Publication; Copyrighted Materials	Gopalakrishman, et al	01/01/2016	Gopalakrishman, K., et al. 2016. Process Development and Optimization for High-Aspect Ration Through-Silicon Via (TSV) Etch. ASMC. 460 – 465.	Electrical and Electronic Components	6	No	Yes	08338
10.15	EPA-HQ-OW-2015-0665-0335	Telephone Communication with Jason Heironimus, Freescale Semiconductor, and Anna Dimling, ERG, Re: Freescale Semiconductor – Oak Hill Facility in Austin, TX - DCN 08339	Telephone conservation between Jason Heironimus, Freescale Semiconductor Oak Hill Facility, and Anna Dimling, Eastern Research Group, Inc. , about Freescale Semiconductor – Oak Hill Facility in Austin, TX.	Meeting Materials	Heironimus, J.	04/07/2016	Heironimus, J. 2016. Telephone communication between Jason Heironimus, Freescale, and Anna Dimling, ERG, Re: Freescale Semiconductor. (April 7).	Electrical and Electronic Components	2	No	No	08339

RECORD SECTION	EPA DOCUMENT ID	TITLE	ABSTRACT	DOCUMENT TYPE	AUTHOR	AUTHOR DATE	SOURCE CITATION	CATEGORY INDUSTRY	PAGE	CBI	COPY - RIGHTED	DCN
10.15	EPA-HQ-OW-2015-0665-0336	Application of Membrane Technology on Semiconductor Wastewater Reclamation: A Pilot-Scale Study - DCN 08340	Researchers performed a pilot-scale study on a three-stage system has been developed for semiconductor wastewater reclamation.	Publication; Copyrighted Materials	Huang, C. J., et al.	05/28/2011	Huang, et al. 2011. Application of Membrane Technology on Semiconductor Wastewater Reclamation: A Pilot-Scale Study. Desalination. 278: 203-210.	Electrical and Electronic Components	8	No	Yes	08340
10.15	EPA-HQ-OW-2015-0665-0337	IBISWorld Industry Report: Earth Potential: International Competition may Outpace Growth Despite Increased Demand - DCN 08341	IBISWorld Industry Report 33441a Semiconductor & Circuit Manufacturing in the US, Earth Potential: International Competition may Outpace Growth Despite Increased Demand.	Publication; Copyrighted Materials	IBISWorld	04/01/2016	IBISWorld. 2016. Earth Potential: International Competition may Outpace Growth Despite Increased Demand. IBISWorld Industry Report 33441a. (April).	Electrical and Electronic Components	41	No	Yes	08341
10.15	EPA-HQ-OW-2015-0665-0338	IBISWorld Industry Report: Circuit Overload: A Strong Dollar will Encourage Imports and Burden Industry Exports - DCN 08342	IBISWorld Industry Report 33441b: Circuit Board and Electronic Component Manufacturing in the US, Circuit Overload: A Strong Dollar will Encourage Imports and Burden Industry Exports.	Publication; Copyrighted Materials	IBISWorld	06/01/2016	IBISWorld. 2016. Circuit Overload: A Strong Dollar will Encourage Imports and Burden Industry Exports. IBISWorld Industry Report 33441b. (June).	Electrical and Electronic Components	35	No	Yes	08342

RECORD SECTION	EPA DOCUMENT ID	TITLE	ABSTRACT	DOCUMENT TYPE	AUTHOR	AUTHOR DATE	SOURCE CITATION	CATEGORY INDUSTRY	PAGE	CBI	COPY - RIGHTED	DCN
10.15	EPA-HQ-OW-2015-0665-0339	Patent for Biological-Chemical Treatment of Liquid Organic Wastewater - DCN 08343	The invention is directed to systems and methods of biological and chemical treatment of wastewater comprising organic nitrogen compounds. Systems may include: an aerobic reactor, a first separation module for separating liquid and solid components of the wastewater; an oxidation module for removing organic materials from the wastewater; and a post-anoxic reactor for denitrifying at least a portion of the wastewater.	Certification	Infilco Degremont Inc.	08/07/2014	Infilco Degremont Inc. 2014. Patent for Biological-Chemical Treatment of Liquid Organic Wastewater: WO 2014120816 A1. (August).	Electrical and Electronic Components	13	No	No	08343
10.15	EPA-HQ-OW-2015-0665-0340	Telephone Communication with Josh Kang, Samsung, and Anna Dimling, ERG, Re: Samsung Austin Semiconductor in Austin, TX - DCN 08344	Telephone conversation between Josh Kang, Samsung Austin Semiconductor, and Anna Dimling, Eastern Research Group, Inc., about Samsung Austin Semiconductor in Austin, TX.	Meeting Materials	Kang, Josh	03/24/2016	Kang, Josh. 2016. Telephone Communication Between Josh Kang, Samsung, and Anna Dimling, ERG, Re: Samsung Austin Semiconductor. (March 24).	Electrical and Electronic Components	1	No	No	08344
10.15	EPA-HQ-OW-2015-0665-0341	Pretreatment of Electronics Wastewater for Reuse: Removal of Calcium Using Controlled Hydrodynamic Cavitation - DCN 08345	Controlled Hydrodynamic Cavitation (CHC) was investigated to remove high calcium levels from the effluent of the fluoride removal process used at a semiconductor manufacturing company; paper presented at WEFTEC.	Publication; Copyrighted Materials	Kim, S., et al	01/01/2011	Kim, S., et al. 2011. Pretreatment of Electronics Wastewater for Reuse: Removal of Calcium Using Controlled Hydrodynamic Cavitation. WEFTEC.	Electrical and Electronic Components	16	No	Yes	08345

RECORD SECTION	EPA DOCUMENT ID	TITLE	ABSTRACT	DOCUMENT TYPE	AUTHOR	AUTHOR DATE	SOURCE CITATION	CATEGORY INDUSTRY	PAGE	CBI	COPY - RIGHTED	DCN
10.15	EPA-HQ-OW-2015-0665-0342	Treatment of Copper Wastewater using Optimal Current Electrochemical–Coagulation - DCN 08346	In this study, an automatic current controlling electrochemical-coagulation (EC) process was developed by testing laboratory scale and pilot-scale reactors for removing copper (Cu) from printed circuit board (PCB) industrial wastewater with an economic use of energy.	Publication; Copyrighted Materials	Kim, K., et al.	05/14/2012	Kim, K., et al. 2012. Treatment of copper wastewater using optimal current electrochemical–coagulation. Environmental Technology. 34: 343-350.	Electrical and Electronic Components	8	No	Yes	08346
10.15	EPA-HQ-OW-2015-0665-0343	Telephone Communication with Gary Marone, Global Foundries, and Anna Dimling, ERG, Re: East Fishkill Facility in Hopewell Junction, NY - DCN 08347	Telephone conversation between Gary Marone, Global Foundries East Fishkill Facility, and Anna Dimling, Eastern Research Group, Inc. , about East Fishkill Facility in Hopewell Junction, NY.	Meeting Materials	Marone, Gary	03/24/2016	Marone, Gary. 2016. Telephone Communication Between Gary Marone, Global Foundries, and Anna Dimling, ERG, Re: East Fishkill Facility. (March 24).	Electrical and Electronic Components	3	No	No	08347
10.15	EPA-HQ-OW-2015-0665-0344	Telephone Communication with John McCoy, Micron Technology, Inc., and Anna Dimling, ERG. Re: Micron Technology Inc. in Manassas, VA - DCN 08348	Telephone conversation between John McCoy, Micron Technology Inc., and Anna Dimling, Eastern Research Group, Inc. , about Micron Technology Inc. in Manassas, VA.	Meeting Materials	McCoy, John	03/24/2016	McCoy, John. 2016. Telephone Communication Between John McCoy, Micron Technology, and Anna Dimling, ERG , Re: Micron Technology. (March 24).	Electrical and Electronic Components	1	No	No	08348

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10.15	EPA-HQ-OW-2015-0665-0345	A Combined Biological and Advanced Oxidation Process for the Treatment of Wastewaters from the Microelectronics Industry - DCN 08349	Several bench scale and pilot scale studies were conducted to investigate complete degradation and/or removal of tetra-methyl ammonium hydroxide (TMAH) employing biological and chemical processes; paper presented at WEFTEC.	Publication; Copyrighted Materials	Mehta, S., et al.	01/01/2014	Mehta, S., et al. 2014. A Combined Biological and Advanced Oxidation Process for the Treatment of Wastewaters. WEFTEC.	Electrical and Electronic Components	11	No	Yes	08349
10.15	EPA-HQ-OW-2015-0665-0346	Application of Struvite Precipitation in Treating Ammonium Nitrogen from Semiconductor Wastewater - DCN 08350	Struvite precipitation was applied to the removal of NH4–N in semiconductor wastewater. Batch experiments were conducted to examine the effects of final pH, magnesium and orthophosphate dosages and the initial influent concentrations of NH4–N and F on the removals of NH4–N and PO4–P by forming struvite deposits.	Publication; Copyrighted Materials	Ryu, H. D., et al.	01/01/2008	Ryu, H. D., et al. 2008. Application of Struvite Precipitation in Treating Ammonium Nitrogen. Journal of Hazardous Materials. 156: 163-169.	Electrical and Electronic Components	7	No	Yes	08350
10.15	EPA-HQ-OW-2015-0665-0347	Technological Evolution and Radical Innovation - DCN 08351	Technological change is perhaps the most powerful engine of growth in markets today. To harness this source of growth, firms need answers to key questions about the dynamics of technological change: (1) How do new technologies evolve? (2) How do rival technologies compete? and (3) How do firms deal with technological evolution?	Publication; Copyrighted Materials	Sood, A., & Tellis, G.	07/01/2005	Sood, A., & Tellis, G. 2005. Technical Evolution and Radical Innovation. Journal of Marketing. July. 69: 152-168.	Electrical and Electronic Components	18	No	Yes	08351

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10.15	EPA-HQ-OW-2015-0665-0348	Pollution Prevention in the Semiconductor Industry through Recovery and Recycling of Gallium and Arsenic from GaAs Polishing Wastes - DCN 08352	A process was developed for the recovery of both arsenic and gallium from gallium arsenide polishing wastes.	Publication; Copyrighted Materials	Sturgill, J. A., et al.	01/01/2000	Sturgill, J. A., et al. 2000. P2 through Recovery and Recycling of Ga and As from GaAs Polishing Wastes. Clean Products and Processes. 2: 18-27.	Electrical and Electronic Components	10	No	Yes	08352
10.15	EPA-HQ-OW-2015-0665-0349	Use of Reverse Osmosis Membranes to Remove Perfluorooctane Sulfonate (PFOS) from Semiconductor Wastewater - DCN 08353	Guidance intended to provide an overview of the semiconductor manufacturing process, discuss the overlap between Parts 469 and 433, and examine new and emerging manufacturing technologies and how these processes fit into the regulatory framework of Parts 469 and 433.	Publication; Copyrighted Materials	Tang, C. Y., et al.	10/05/2006	Tang, C. Y., et al. 2006. Use of RO Membranes to Remove PFOS from Semiconductor Wastewater. Environmental Science & Technology. 40(23): 7343-7349.	Electrical and Electronic Components	7	No	Yes	08353
10.15	EPA-HQ-OW-2015-0665-0350	United States Census Bureau: 2007 NAICS Definition for 334411 Electron Tube Manufacturing - DCN 08354	U.S. Census Bureau NAICS 334411 Electron Tube Manufacturing definition.	Data	U.S. Census Bureau	08/03/2016	U.S. Census Bureau. 2016. 2007 NAICS Definition for 334411 Electron Tube Manufacturing.	Electrical and Electronic Components	2	No	No	08354

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10.15	EPA-HQ-OW-2015-0665-0351	United States Census Bureau. Economic Census - DCN 08355	Economic Census	Data	U.S. Census Bureau	01/01/2016	U.S. Census Bureau. 2016. United States Census Bureau. Economic Census.	Electrical and Electronic Components	2	No	No	08355
10.15	EPA-HQ-OW-2015-0665-0352	Development Document for Effluent Limitations Guidelines and Standards for the Electrical and Electronic Components Point Source Category – Phase II - DCN 08356	Technical documentation for discharge limitations guidelines and standards for the E&EC industry established by EPA. This document focuses on the Cathode Ray Tube and Luminscent Materials Subcategories.	Publication, U.S. EPA	U.S. EPA	12/01/1983	U.S. EPA. 1983. Development Document for ELGs for the E&EC PSC – Phase II. Washington, D.C. (December). EPA 440/1-84/075.	Electrical and Electronic Components	175	No	No	08356
10.15	EPA-HQ-OW-2015-0665-0353	Permitting Guidance for Semiconductor Manufacturing Facilities - DCN 08357	Guidance intended to provide an overview of the semiconductor manufacturing process, discuss the overlap between Parts 469 and 433, and examine new and emerging manufacturing technologies and how these processes fit into the regulatory framework of Parts 469 and 433.	Publication, U.S. EPA	U.S. EPA	04/21/1998	U.S. EPA. 1998. Permitting Guidance for Semiconductor Manufacturing Facilities. Washington, DC. (April).	Electrical and Electronic Components	15	No	No	08357

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10.15	EPA-HQ-OW-2015-0665-0354	Telephone Communication with Ryan Wasielewski, Powerex, Inc., and Anna Dimling, ERG. Re: Powerex Inc. in Youngwood, PA. - DCN 08358	Telephone conversation between Ryan Wasielewski, Powerex Inc., and Anna Dimling, Eastern Research Group, Inc. , about Powerex Inc. in Youngwood, PA.	Meeting Materials	Wasielewski, Ryan	04/04/2016	Wasielewski, Ryan. 2016. Telephone Communication Between Ryan Wasielewski, Powerex Inc., and Anna Dimling, ERG, Re: Powerex Inc. (April 4).	Electrical and Electronic Components	2	No	No	08358
10.15	EPA-HQ-OW-2015-0665-0355	Summary Notes from EPA's Meeting with the National Association of Clean Water Agencies (NACWA) - DCN 08359	Notes from EPA's Meeting with the National Association of Clean Water Agencies (NACWA) on December 5, 2016	Meeting Materials	U.S. EPA	12/05/2016	U.S. EPA. 2016. Summary Notes from EPA's Meeting with the National Association of Clean Water Agencies (NACWA). (December).	Electrical and Electronic Components	3	No	No	08359
10.27	EPA-HQ-OW-2015-0665-0412	Generating 'Light Work' Removing Heavy Metals - DCN 08420	Copper is increasingly becoming a heavy metal of concern. A new technology was recently developed to treat it without chemicals or pretreatment.	Publication	Aldave, R., & Buday, S.	11/01/2011	Aldave, R., & Buday, S. 2011. Generating 'Light Work' Removing Heavy Metals. Pollution Engineering. (October).	Iron and Steel Manufacturing	4	No	No	08420

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10.27	EPA-HQ-OW-2015-0665-0413	Telephone and Email Communication Between Chris T. Artrip, SWVA Inc., and Bushra Alam, ERG, Re: 2014 TRI Lead Releases for SWVA Inc., in Huntington, WV. - DCN 08421	Telephone and email conversation between Chris T. Artrip, SWVA Inc., and Bushra Alam, Eastern Research Group, Inc., about 2014 TRI Lead Releases for SWVA Inc., in Huntington, WV.	Meeting Materials	Artrip, Chris	03/23/2016	Artrip, C. 2016. Communication Between Chris T. Artrip, SWVA Inc., and Bushra Alam, ERG, Re: 2014 TRI Lead Releases for SWVA Inc. (March 23).	Iron and Steel Manufacturing	4	No	No	08421
10.27	EPA-HQ-OW-2015-0665-0414	Telephone and Email Communication Between Jason Banks, DW-National Standard-Stillwater LLC, and Bushra Alam, ERG, Re: 2014 TRI Lead and Copper Releases - DCN 08422	Telephone and email conversation between Jason Banks, DW-National Standard- Stillwater LLC, and Bushra Alam, Eastern Research Group, Inc. about 2014 TRI Lead and Copper Releases.	Meeting Materials	Banks, Jason	03/24/2016	Banks, J. 2016. Communication Between Jason Banks, DW-National Standard-Stillwater LLC, and Bushra Alam, ERG, Re: 2014 TRI Releases. (March 24).	Iron and Steel Manufacturing	4	No	No	08422
10.27	EPA-HQ-OW-2015-0665-0415	Telephone and Email Communication Between Doug Bley, ArcelorMittal Burns Harbor, and Kimberly Bartell, ERG. Re: 2014 TRI Lead Discharges - DCN 08423	Telephone and email conversation between Doug Bley, ArcelorMittal Burns Harbor, and Kimberly Bartell, Eastern Research Group, Inc. about 2014 TRI Lead Discharges.	Meeting Materials	Bley, Doug	03/21/2016	Bley, Doug. 2016. Communication Between Doug Bley, ArcelorMittal Burns Harbor, and Kimberly Bartell, ERG, Re: 2014 TRI Lead Discharges. (March 21).	Iron and Steel Manufacturing	5	No	No	08423

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10.27	EPA-HQ-OW-2015-0665-0416	Three Years of Full-Scale Treatment of an Oily Wastewater Using an Immersed Membrane Biological Reactor - DCN 08424	Summary of pilot work that was conducted on an immersed membrane biological reactor (MBR) system, using a prototype of commercially available equipment. The MBR testing results demonstrated that the primary target compounds (BOD5, COD, TSS, BTEX and oil and grease) and metals (arsenic, lead, mercury and zinc) were removed at rates of 85 to 99 percent and were within local discharge limitations.	Publication; Copyrighted Materials	Buckles, J., et al	01/01/2007	Buckles, J., et al. 2007. Three Years of Full-Scale Treatment of an Oily Wastewater Using an Immersed Membrane Biological Reactor. WEFTEC.	Iron and Steel Manufacturing	12	No	Yes	08424
10.27	EPA-HQ-OW-2015-0665-0417	Telephone and Email Communication Between Deborah Calderazzo, Jewel Acquisition LLC-Louisville, and Bushra Alam, ERG. Re: 2014 TRI Lead, Manganese, Nitrate, and Copper Releases at Jewel Acquisition LLC - DCN 08425	Telephone and email conversation between Deborah Calderazzo, Jewel Acquisition LLC- Louisville, and Bushra Alam, Eastern Research Group, Inc. about 2014 TRI Lead, Manganese, Nitrate, and Copper Releases at Jewel Acquisition LLC.	Meeting Materials	Calderazzo, Deborah	03/31/2016	Calderazzo, D. 2016. Communication Between Deborah Calderazzo, Jewel, and Bushra Alam, ERG. Re: 2014 TRI Releases at Jewel Acquisition. (March 31).	Iron and Steel Manufacturing	4	No	No	08425
10.27	EPA-HQ-OW-2015-0665-0418	Telephone and Email Communication Between Rick Clifton, IPSCO Tubular (Kentucky) Inc., and Bushra Alam, ERG, Re: 2014 TRI Lead and Manganese Releases at IPSCO Tubular (Kentucky) Inc. - DCN 08426	Telephone and email conversation between Rick Clifton, IPSCO Tubular (Kentucky) Inc., and Bushra Alam, Eastern Research Group, Inc., about 2014 TRI Lead and Manganese Releases at IPSCO Tubular (Kentucky) Inc.	Meeting Materials	Clifton, Rick	03/23/2016	Clifton, R. 2016. Communication Between Rick Clifton, IPSCO, and Bushra Alam, ERG. Re: 2014 TRI Releases at IPSCO. (March 23).	Iron and Steel Manufacturing	1	No	No	08426

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10.27	EPA-HQ-OW-2015-0665-0419	Acid Mine Drain (AMD) Treatment to Achieve Very Low Residual Heavy Metal Concentrations - DCN 08427	Summary of pilot studies using a dissolved air flotation (GEM System) and walnut filters. The GEM System and the walnut filters can be used as a replacement for current technologies.	Publication; Copyrighted Materials	Colic, M., & Hogan, J	01/01/2012	Colic, M., & Hogan, J. 2012. Acid Mine Drain (AMD) Treatment to Achieve Very Low Residual Heavy Metal Concentrations. WEFTEC.	Iron and Steel Manufacturing	23	No	Yes	08427
10.27	EPA-HQ-OW-2015-0665-0420	Heavy Metals Removal by Sand Filters Inoculated with Metal Sorbing and Precipitating Bacteria - DCN 08428	Large volumes of wastewater containing metals such as Cd, Zn, Cu, Pb, Hg, Ni or Co are mainly treated by precipitation processes. However, waters treated in such ways do not always meet regulatory standards. And in many cases, ecotaxes must be paid on the heavy metals load in the discharged water. Therefore, a second polishing treatment is often necessary. The use of sand filters inoculated with heavy metal biosorbing and bioprecipitating bacteria fulfils these objectives.	Publication; Copyrighted Materials	Diels, L., et al	01/01/2003	Diels, L., et al. 2003. Heavy Metals Removal by Sand Filters Inoculated with Metal Sorbing and Precipitating Bacteria. Hydrometallurgy. 71: 235–241.	Iron and Steel Manufacturing	7	No	Yes	08428
10.27	EPA-HQ-OW-2015-0665-1053	Continued Preliminary Category Review – Facility Data Review and Calculations for Point Source Category – 420 –Iron and Steel Manufacturing - DCN 08429	Facility Data Review and Calculations for Point Source Category – 420 – Iron and Steel Manufacturing for the ELG Planning Review Report Supporting the Final 2016 ELG Plan.	Data	ERG	09/01/2016	ERG. 2016. Continued Preliminary Category Review – Facility Data Review and Calculations for PSC – 420 –I&S Manufacturing. Chantilly, VA. (Sept).	Iron and Steel Manufacturing	0	No	No	08429

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10.27	EPA-HQ-OW-2015-0665-0421	Pilot Testing of Selenium Removal in a Surface Coal Mine Water Containing High Nitrate and Selenium Concentrations - DCN 08430	Pilot testing of an anoxic fluidized bed reactor (FBR) technology for selenium (Se) removal from runoff water at Teck Coal Limited's Line Creek mining operation was conducted in 2011. Based on pilot testing results, a subsequent conceptual treatment alternatives evaluation identified FBR based treatment to be the most feasible and cost effective technology for full scale application.	Publication; Copyrighted Materials	Gay, M., et al	01/01/2012	Gay, M., et al. 2012. Pilot Testing of Selenium Removal in a Surface Coal Mine Water Containing High Nitrate and Selenium Concentrations. WEFTEC.	Iron and Steel Manufacturing	18	No	Yes	08430
10.27	EPA-HQ-OW-2015-0665-0422	Telephone and Email Communication Between Jonathan Hacker, Valbruna Slater Stainless Inc., and Bushra Alam, ERG. Re: 2014 TRI Copper and Manganese Discharges at Valbruna Slater Stainless Inc. - DCN 08431	Telephone and email conversation between Jonathan Hacker, Valbruna Slater Stainless Inc., and Bushra Alam, Eastern Research Group, Inc., about 2014 TRI Copper and Manganese Discharges at Valbruna Slater Stainless Inc.	Meeting Materials	Hacker, Jonathan	06/23/2016	Hacker, J. 2016. Communication Between Jonathan Hacker, Valbruna, and Bushra Alam, ERG. Re: 2014 TRI Discharges at Valbruna. (June 23).	Iron and Steel Manufacturing	4	No	No	08431
10.27	EPA-HQ-OW-2015-0665-0423	Removal of Selenium in Refinery Effluent with Adsorption Media - DCN 08432	In this study, selenium was removed from various refinery effluent waters, in field applications, and at the source point stripper sour water. In addition, this single pass treatment option also removed vanadium, arsenic, mercury, barium, etc.	Publication; Copyrighted Materials	Hayes, M. & Sherwood, N.	01/01/2012	Hayes, M., & Sherwood, N. 2012. Removal of Selenium in Refinery Effluent with Adsorption Media. WEFTEC.	Iron and Steel Manufacturing	12	No	Yes	08432

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10.27	EPA-HQ-OW-2015-0665-0424	Telephone and Email Communication Between Richard Herman, NLMK Pennsylvania Corp., and Bushra Alam, ERG. Re: 2014 TRI Releases at NLMK Pennsylvania Corp. - DCN 08433	Telephone and email conversation between Richard Herman, NLMK Pennsylvania Corp., and Bushra Alam, Eastern Research Group, Inc., about 2014 TRI Releases at NLMK Pennsylvania Corp.	Meeting Materials	Herman, Richard	03/24/2016	Herman, R. 2016. Communication Between Richard Herman, NLMK, and Bushra Alam, ERG., Re: 2014 TRI Releases at NLMK. (March 24).	Iron and Steel Manufacturing	4	No	No	08433
10.27	EPA-HQ-OW-2015-0665-0425	Microsand Ballasted Flocculation and Clarification: Effects on Removal of TSS, Oil & Grease, and Metals from a Steel Mill Waste Stream. - DCN 08434	A seventeen-day pilot operation demonstrated the feasibility of microsand ballasted flocculation and clarification for removal of TSS, oil & grease, and multiple regulated metals from steel plant wastewater. The process was insensitive to varying influent conditions tested including normal and simulated “worst case” conditions.	Publication; Copyrighted Materials	Kessler, Carol	01/01/2002	Kessler, C. 2002. Microsand Ballasted Flocculation and Clarification: Effects on Removal of TSS, O&G, and Metals from a Steel Mill. WEFTEC.	Iron and Steel Manufacturing	16	No	Yes	08434
10.27	EPA-HQ-OW-2015-0665-0426	Telephone and Email Communication Between Brandon Killian, ADCOM Wire Co., and Bushra Alam, ERG. Re: 2014 TRI Manganese and Nitrate Discharges at ADCOM Wire. Co. - DCN 08435	Telephone and email conversation between Brandon Killian, ADCOM Wire Co., and Bushra Alam, Eastern Research Group, Inc., about 2014 TRI Manganese and Nitrate Discharges at ADCOM Wire. Co.	Meeting Materials	Killian, Brandon	04/04/2016	Killian, B. 2016. Communication Between Brandon Killian, ADCOM Wire Co., and Bushra Alam, ERG. Re: 2014 TRI Discharges. (April 4).	Iron and Steel Manufacturing	4	No	No	08435

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10.27	EPA-HQ-OW-2015-0665-0427	Telephone and Email Communication Between Brian Lasko, US Steel, and Kimberly Bartell, ERG. Re: 2014 TRI Lead, Manganese, Copper, and Nitrate Discharges for US Steel facilities. - DCN 08436	Telephone and email conversation between Brian Lasko, US Steel, and Kimberly Bartell, Eastern Research Group, Inc., about 2014 TRI Lead, Manganese, Copper, and Nitrate Discharges.	Meeting Materials	Lasko, Brian	03/31/2016	Lasko, B. 2016. Communication Between Brian Lasko, US Steel, and Kim Bartell, ERG. Re: 2014 TRI Discharges. (March 31).	Iron and Steel Manufacturing	40	No	No	08436
10.27	EPA-HQ-OW-2015-0665-0428	Telephone and Email Communication Between John Lockhart, West Virginia Department of Environmental Protection, and Kimberly Bartell, ERG. Re: OCPSF and Iron and Steel Facility Permitting Practices in West Virginia. - DCN 08437	Telephone and email conversation between John Lockhart, West Virginia Department of Environmental Protection, and Kimberly Bartell, Eastern Research Group, Inc., about OCPSF and Iron and Steel Facility Permitting Practices in West Virginia.	Meeting Materials	Lockhart, John	03/28/2016	Lockhart, J. 2016. Communication Between John Lockhart, WV DEP, and Kim Bartell, ERG. Re: Permitting Practices in West Virginia. (March 28).	Iron and Steel Manufacturing	3	No	No	08437
10.27	EPA-HQ-OW-2015-0665-0429	Telephone and Email Communication Between Sean McGowan, Carpenter Technology Corp., and Bushra Alam, ERG. Re: 2014 TRI Copper Releases at Carpenter Technology Corp. - DCN 08438	Telephone and email conversation between Sean McGowan, Carpenter Technology Corp., and Bushra Alam, Eastern Research Group, Inc., about 2014 TRI Copper Releases at Carpenter Technology Corp.	Meeting Materials	McGowan, Sean	03/29/2016	McGowan, S. 2016. Communication Between Sean McGowan, Carpenter, and Bushra Alam, ERG. Re: 2014 TRI Releases. (March 29).	Iron and Steel Manufacturing	3	No	No	08438

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10.27	EPA-HQ-OW-2015-0665-0430	Telephone and Email Communication Between Mike Mieczkowski, ArcelorMittal Weirton LLC, and Bushra Alam, ERG. Re: 2014 TRI Lead, Manganese, and Copper Releases at ArcelorMittal LLC (Weirton) - DCN 08439	Telephone and email conversation between Mike Mieczkowski, ArcelorMittal Weirton LLC, and Bushra Alam, Eastern Research Group, Inc., about 2014 TRI Lead, Manganese, and Copper Releases at ArcelorMittal LLC (Weirton).	Meeting Materials	Mieczkowski, Mike	03/28/2016	Mieczkowski, M. 2016. Communication Between Mike Mieczkowski, ArcelorMittal Weirton LLC, and Bushra Alam, ERG., Re: 2014 TRI Releases. (March 28).	Iron and Steel Manufacturing	6	No	No	08439
10.27	EPA-HQ-OW-2015-0665-0431	Telephone and Email Communication Between Matt Montag, AK Steel Corp Coshocton Works, and Bushra Alam, ERG. Re: 2014 TRI Manganese and Nitrate Discharges at AK Steel Corp. - DCN 08440	Telephone and email conversation between Matt Montag, AK Steel Corp Coshocton Works, and Bushra Alam, ERG, about 2014 TRI Manganese and Nitrate Discharges at AK Steel Corp.	Meeting Materials	Montag, Matt	04/04/2015	Montag, M. 2016. Communication Between Matt Montag, AK Steel Corp Coshocton Works, and Bushra Alam, ERG, Re: 2014 TRI Discharges. (April 4).	Iron and Steel Manufacturing	4	No	No	08440
10.27	EPA-HQ-OW-2015-0665-0432	The Use of Constructed Wetlands in the Treatment of Flue Gas Desulfurization Wastewater - DCN 08441	A major power producer has decided to undertake a constructed wetland treatment system pilot project to evaluate the technology. The constructed wetland, currently in operation, is approximately 2 acres in size and treats approximately 7 percent of the plant FGD wastewater stream.	Publication	Morrison, J., et al.	01/01/2011	Morrison, J., et al. 2011. The Use of Constructed Wetlands in the Treatment of Flue Gas Desulfurization Wastewater. IWC.	Iron and Steel Manufacturing	14	No	No	08441

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10.27	EPA-HQ-OW-2015-0665-0433	Aquatic Toxicity Reduction and Water Reuse at a Metal Finishing Plant - DCN 08442	In 2003, the Bon L Manufacturing Company took the final steps to meet the aquatic toxicity requirements of its NPDES permit. Prior to the final steps, Bon L had implemented water and waste minimization measures within the manufacturing plant to reduce water usage and waste generation.	Publication; Copyrighted Materials	Patrick, G., et al.	01/01/2008	Patrick, G., et al. 2008. Aquatic Toxicity Reduction and Water Reuse at a Metal Finishing Plant. WEFTEC.	Iron and Steel Manufacturing	12	No	Yes	08442
10.27	EPA-HQ-OW-2015-0665-0434	Remote High-Altitude Pilot Treatment System for Mining-Impacted Waters - DCN 08443	A mostly-passive pilot treatment system (PTS) consisting of a biochemical reactor (BCR) and an aerobic polishing cell (APC), was installed as part of a treatability study to evaluate this innovative technology in a unique environment. The system was developed to test whether a PTS, that uses less energy and has only intermittent need for operations personnel, can work effectively at high altitudes in extreme cold conditions.	Publication; Copyrighted Materials	Progress, C., et al.	01/01/2012	Progress, C., et al. 2012. Remote High-Altitude Pilot Treatment System for Mining-Impacted Waters. WEFTEC.	Iron and Steel Manufacturing	4	No	Yes	08443
10.27	EPA-HQ-OW-2015-0665-0435	One Automotive Manufacturer: Three Membrane Applications for Wastewater Pretreatment and Reuse - DCN 08444	Automotive manufacturing operations at two Chrysler facilities have recently expanded to increase production and modernize manufacturing processes.	Publication; Copyrighted Materials	Pugh, L., et al.	01/01/2014	Pugh, L., et al. 2014. One Automotive Manufacturer: Three Membrane Applications for Wastewater Pretreatment and Reuse. WEFTEC.	Iron and Steel Manufacturing	27	No	Yes	08444

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10.27	EPA-HQ-OW-2015-0665-0436	Telephone and Email Communication Between Stan Rigney, Indiana Department of Environmental Management, and Bushra Alam, ERG. Re: Permitting of Iron and Steel facilities - DCN 08445	Telephone and email conversation between Stan Rigney, Indiana Department of Environmental Management, and Bushra Alam, Eastern Research Group, Inc., about Permitting of Iron and Steel facilities.	Meeting Materials	Rigney, Stan	03/23/2016	Rigney, S. 2016. Communication Between Stan Rigney, IN DEM, and Bushra Alam, ERG. Re: Permitting of Iron and Steel facilities. (March 24).	Iron and Steel Manufacturing	2	No	No	08445
10.27	EPA-HQ-OW-2015-0665-0437	Telephone and Email Communication Between Randall Welsh, O&K American Corp., and Bushra Alam, ERG. Re: 2014 TRI Manganese and Nitrate Releases at O&K American Corp. - DCN 08446	Telephone and email conversation between Randall Welsh, O&K American Corp., and Bushra Alam, Eastern Research Group, Inc. about 2014 TRI Manganese and Nitrate Releases at O&K American Corp.	Meeting Materials	Welsh, R.	04/14/2016	Welsh, R. 2016. Communication Between Randall Welsh, O&K American Corp., and Bushra Alam, ERG. Re: 2014 TRI Releases. (April 14).	Iron and Steel Manufacturing	3	No	No	08446
10.27	EPA-HQ-OW-2015-0665-0438	Reverse Osmosis Applied to Metal Finishing Wastewater - DCN 08447	The electroplating industry is a great water consumer and, as a consequence, one of the biggest producers of liquid effluent. The metal finishing industry presents one of the most critical industrial waste problems. There is therefore growing interest in developing methods for reclaiming metals from plating waste stream and recovery of water using membrane technology. The application of RO to the global effluent from the electroplating industry has been studied in this paper.	Publication; Copyrighted Materials	Benito, Y. & Ruiz, M. L.	01/01/2002	Benito, Y., and Ruiz, M. L. 2002. Reverse Osmosis Applied to Metal Finishing Wastewater. Desalination. 142: 229-234.	Metal Finishing	6	No	Yes	08447

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10.27	EPA-HQ-OW-2015-0665-0439	Water Reuse in an Oil Refinery: An Innovative Solution Using Membrane Technology - DCN 08448	An oil refinery located in Texas, USA is interested in reusing wastewater as process water to achieve two objectives: reduce its potable water consumption and reduce wastewater disposal costs. A pilot study was performed to demonstrate the feasibility of reusing treated wastewater as makeup water for boiler feed and cooling tower. The pilot system consisted of three unit operations: ZeeWeed® UF, strong acid cation exchange softening (IX) and RO.	Publication; Copyrighted Materials	Ginzburg & Cansino	01/01/2009	Ginzburg, B., & Cansino, R. (2009). Water Reuse in an Oil Refinery: An Innovative Solution Using Membrane Technology. Paper presented at the WEFTEC.	Petroleum Refining	11	No	Yes	08448
10.27	EPA-HQ-OW-2015-0665-0440	Selenium Treatment of Mine Water Effluent in a Fluidized Bed Reactor (FBR) - DCN 08449	A pilot study was conducted to evaluate Selenium (Se) removal from a surface coal mine effluent stream by a biological fluidized bed reactor (FBR). FBR treatment technology is well proven for nitrate and perchlorate removal and utilizes heterotrophic facultative bacteria that use oxidized selenium species as electron acceptors and reduce them to elemental Se under anoxic/anaerobic conditions.	Publication; Copyrighted Materials	Munirathinam, K. R.	01/01/2011	Munirathinam, K. R., et al. (2011). Selenium Treatment of Mine Water Effluent in a Fluidized Bed Reactor (FBR). Paper presented at the WEFTEC.	Coal Mining	21	No	Yes	08449
10.27	EPA-HQ-OW-2015-0665-0441	Biological Treatment Helps Remove Nitrate, Sulfate from Mine Runoff - DCN 08450	Nitrate and sulfate are common contaminants in surface water and groundwater associated with mining operations. Three biological treatment systems have successfully removed nitrate and sulfate at the Kettle River Operations near Republic, WA, since their construction in 2005-06. Treatment is accomplished with a combination of engineered reactors and in situ treatment.	Publication; Copyrighted Materials	Reinsel, Mark.	01/01/2010	Reinsel, Mark. (2010). Biological Treatment Helps Remove Nitrate, Sulfate form Mine Runoff. Industrial WaterWorld, 10(1).	Mineral Mining and Processing	2	No	Yes	08450

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10.27	EPA-HQ-OW-2015-0665-0442	Use of ozone in a pilot-scale plant for textile wastewater pre-treatment: Physico-chemical efficiency, degradation by-products identification and environmental toxicity of treated wastewater - DCN 08451	In this study, ozonation of raw textile wastewater was conducted in a pilot-scale plant and the efficiency of this treatment was evaluated based on the parameters color removal and soluble organic matter measured as COD, at two pH values. In conclusion, pre-ozonation of textile wastewater is an important step in terms of improving wastewater biodegradability, as well as reducing acute ecotoxicity, which should be removed completely through sequential biological treatment.	Publication; Copyrighted Materials	Somensi, C. A., et al.	10/06/2009	Somensi, C. et al. (2010). Use of Ozone in A Pilot-Scale Plant for Textile Wastewater Pre-Treatment. Journal of Hazardous Materials 175, 235- 240.	Textile Mills	6	No	Yes	08451
10.27	EPA-HQ-OW-2015-0665-0443	EPCRA Section 313 Reporting Guidance for Food Processors - DCN 08452	This document is intended to assist establishments and facilities designated by SIC Major Group 20 in complying with the Emergency Planning and Community Right-To-Know Act (EPCRA) Section 313 reporting requirements, the preparation of Form R or Form A. The EPCRA Section 313 program is commonly referred to as TRI.	Publication; USEPA	U.S. EPA	09/01/1998	U.S. EPA. 1998 . EPCRA Section 313 Reporting Guidance for Food Processors. OPPT. EPA-745-R-98-011. (Sept).	Miscellaneous Food and Beverages	160	No	No	08452
10.27	EPA-HQ-OW-2015-0665-0444	2013 TRI Chemical List - DCN 08453	Individually listed EPCRA Section 313 chemicals with CAS numbers arranged alphabetically, then by CAS number.	Publication; USEPA	U.S. EPA	11/25/2013	U.S. EPA. 2014. 2013 TRI Chemical List. Toxics Release Inventory Program. Washington, D.C.		21	No	No	08453

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10.27	EPA-HQ-OW-2015-0665-0445	Comparing Clean Water Act (CWA) National Pollutant Discharge Elimination System (NPDES) Discharge Monitoring Report (DMR) Data and Toxics Release Inventory (TRI) Data - DCN 08454	This document provides additional background on the two main sources of wastewater pollution data supporting EPA's DMR Pollutant Loading Tool or "Loading Tool" (http://cfpub.epa.gov/dmr/). In particular, this document offers insights on how to compare these two data sources, Discharge Monitoring Reports (DMR) and Toxics Release Inventory (TRI), as well as considerations for analysis and interpretation.	Publication; USEPA	U.S. EPA	12/01/2014	U.S. EPA. 2014. Comparing CWA NPDES DMR Data and TRI Data. Washington, D.C. (Dec).	Iron and Steel Manufacturing	20	No	No	08454
10.27	EPA-HQ-OW-2015-0665-0809	Telephone and Email Communication Between Matt Gill, Alton Steel, and Sara Bossenbroek, ERG. Re: 2014 DMR Manganese Releases - DCN 08541	Telephone and email conversation between Matt Gill, Alton Steel, and Sara Bossenbroek, Eastern Research Group, Inc. about 2014 DMR Manganese Releases.	Meeting Material	Gill, Matt	11/28/2016	Gill, M. 2016. Communication between Matt Gill, Alton Steel, and Sara Bossenbroek, ERG. Re: 2014 DMR Manganese Discharges. (Nov28).	Iron and Steel Manufacturing	3	No	No	08541
10.27	EPA-HQ-OW-2015-0665-0810	Indiana Administrative Code: Title 327 Water Pollution Control Division, Article 2: Water Quality Standards - DCN 08542	Article 2. Water Quality Standards from the Indiana General Assembly. Written standards for water-quality-based limits for the state.	Publication Other Government	Indiana	01/01/2016	Indiana General Assembly. 2016 . Indiana Administrative Code: Title 327 Water Pollution Control Division, Article 2: Water Quality Standards.	Iron and Steel Manufacturing	136	No	No	08542

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10.27	EPA-HQ-OW-2015-0665-0811	Telephone and Email Communication Between Patrick Smith, Mountain State Carbon, and Kim Bartell, ERG. Re: 2014 DMR Manganese, Nitrate, and Phosphorus Discharges - DCN 08543	Telephone and email conversation between Patrick Smith, Mountain State Carbon, and Kim Bartell, Eastern Research Group, Inc. about 2014 DMR Manganese, Nitrate, and Phosphorus Discharges.	Meeting Material	Smith, Patrick	11/28/2016	Smith, P. 2016. Communication between Patrick Smith, Mountain State Carbon, and Kim Bartell, ERG. Re: 2014 DMR Discharges. (Nov 28).	Iron and Steel Manufacturing	4	No	No	08543
10.39	EPA-HQ-OW-2015-0665-0473	Telephone Communication Between Reuel Anderson, Nebraska DEQ, and Kimberly Bartell, ERG. Re: 2014 OCPSF Total Residual Chlorine Permitting - DCN 08483	Telephone conversation between Reuel Anderson, Nebraska DEQ, and Kimberly Bartell, Eastern Research Group, Inc. about 2014 OCPSF Total Residual Chlorine Permitting.	Meeting Materials	Anderson, R.	03/23/2016	Anderson, R. 2016. Communication Between Reuel Anderson, NE DEQ, and Kim Bartell, ERG. Re: 2014 OCPSF TRC Permitting. (March 23).	OCPSF (Organic Chemicals, Plastics and Synthetic Fibers)	1	No	No	08483
10.39	EPA-HQ-OW-2015-0665-0474	Telephone and Email Communication Between Bob Burke, Ascend Performance Materials, and Kimberly Bartell, ERG. Re: 2014 TRI Nitrate Discharges - DCN 08484	Telephone and email conversation between Bob Burke, Ascend Performance Materials, and Kimberly Bartell, Eastern Research Group, Inc., about 2014 TRI Nitrate Discharges.	Meeting Materials	Burke, B.	03/30/2016	Burke, B. 2016. Communication Between Bob Burke, Ascend Performance Materials, and Kim Bartell, ERG. Re: 2014 TRI Nitrate Discharges. (March 30).	OCPSF (Organic Chemicals, Plastics and Synthetic Fibers)	12	No	No	08484

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10.39	EPA-HQ-OW-2015-0665-0475	Telephone and Email Communication Between Beth Connell, DSM Chemicals NA Inc., and Kimberly Bartell, ERG. Re: 2014 TRI Nitrate Discharges - DCN 08485	Telephone and email conversation between Beth Connell, DSM Chemicals NA Inc., and Kimberly Bartell, Eastern Research Group, Inc., about 2014 TRI Nitrate Discharges.	Meeting Materials	Connell, B.	03/21/2016	Connell, B. 2016. Communication Between Beth Connell, DSM Chemicals NA Inc., and Kimberly Bartell, ERG. Re: 2014 TRI Nitrate Discharges. (March 21).	OCPSF (Organic Chemicals, Plastics and Synthetic Fibers)	5	No	No	08485
10.39	EPA-HQ-OW-2015-0665-1055	Continued Preliminary Category Review – Facility Data Review and Calculations for Point Source Category – 414 – Organic Chemicals, Plastics and Synthetic Fibers - DCN 08486	Facility Data Review and Calculations for Point Source Category 414 - Organic Chemicals, Plastics and Synthetic Fibers for the ELG Planning Review Report Supporting the Final 2016 ELG Plan.	Data	Eastern Research Group (ERG)	09/01/2016	ERG. 2016. Continued Preliminary Category Review – Facility Data Review and Calculations for PSC 414 – OCPSF. Chantilly, VA. (Sept).	OCPSF (Organic Chemicals, Plastics and Synthetic Fibers)	0	No	No	08486
10.39	EPA-HQ-OW-2015-0665-0476	Telephone and Email Communication Between Cari Field, First Chemical Corporation, and Kimberly Bartell, ERG. Re: 2014 TRI Nitrate Discharges - DCN 08487	Telephone and email conversation between Cari Field, First Chemical Corporation, and Kimberly Bartell, Eastern Research Group, Inc., about 2014 TRI Nitrate Discharges.	Meeting Materials	Field, C.	03/23/2016	Field, C. 2016. Communication Between Cari Field, First Chemical Corporation, and Kim Bartell, ERG. Re: 2014 TRI Nitrate Discharges. (March 23).	OCPSF (Organic Chemicals, Plastics and Synthetic Fibers)	5	No	No	08487

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10.39	EPA-HQ-OW-2015-0665-0477	Telephone and Email Communication Between Shannon Gibson, Texas CEQ, and Kimberly Bartell, ERG. Re: 2014 OCPSF Total Residual Chlorine Permitting Processes - DCN 08488	Telephone and email conversation between Shannon Gibson, Texas CEQ, and Kimberly Bartell, Eastern Research Group, Inc., about 2014 OCPSF Total Residual Chlorine Permitting Processes.	Meeting Materials	Gibson, S.	03/23/2016	Gibson, S. 2016. Communication Between Shannon Gibson, Texas CEQ, and Kim Bartell, ERG. Re: 2014 OCPSF TRC Permitting Processes. (March 23).	OCPSF (Organic Chemicals, Plastics and Synthetic Fibers)	6	No	No	08488
10.39	EPA-HQ-OW-2015-0665-0478	Telephone and Email Communication Between Wendy Hieb, Iowa DNR, and Amie Aguiar, ERG. Re: 2014 OCPSF Total Residual Chlorine Permitting - DCN 08489	Telephone and email conversation between Wendy Hieb, Iowa DNR, and Amie Aguiar, Eastern Research Group, Inc., about 2014 OCPSF Total Residual Chlorine Permitting.	Meeting Materials	Hieb, W.	03/23/2016	Hieb, W. 2016. Communication Between Wendy Hieb, Iowa DNR, and Amie Aguiar, ERG. Re: 2014 OCPSF Total Residual Chlorine Permitting. (March 23).	OCPSF (Organic Chemicals, Plastics and Synthetic Fibers)	2	No	No	08489
10.39	EPA-HQ-OW-2015-0665-0479	Telephone and Email Communication Between Eric Hillamn, BASF Corp., and Kimberly Bartell, ERG. Re: 2014 TRI Nitrate Discharges - DCN 08490	Telephone and email conversation between Eric Hillamn, BASF Corp., and Kimberly Bartell, Eastern Research Group, Inc., about 2014 TRI Nitrate Discharges	Meeting Materials	Hillaman, E.	03/30/2016	Hillamn, Eric. 2016. Communication Between Eric Hillamn, BASF Corp., and Kimberly Bartell, ERG. Re: 2014 TRI Nitrate Discharges. (March 30).	OCPSF (Organic Chemicals, Plastics and Synthetic Fibers)	1	No	No	08490

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10.39	EPA-HQ-OW-2015-0665-0480	Iowa Department of Natural Resources (IA DNR). National Pollutant Discharge Elimination System Facility Permit and Fact Sheet for NPDES IA0079456 - The Andersons Denison Ethanol, LLC, Denison, IA - DCN 08491	NPDES Facility Permit and Fact Sheet for The Andersons Denison Ethanol, LLC, Denison, IA - IA0079456.	Permit/ Registration	IA DNR	01/01/2011	IA DNR. 2011. NPDES Permit and Fact Sheet for The Andersons Denison Ethanol, LLC, Denison, IA - IA0079456. (January 1).	OCPSF (Organic Chemicals, Plastics and Synthetic Fibers)	18	No	No	08491
10.39	EPA-HQ-OW-2015-0665-0481	Iowa Department of Natural Resources (IA DNR). National Pollutant Discharge Elimination System Facility Permit and Fact Sheet for NPDES IA0081043 - Southwest Iowa Renewable Energy, Council Bluffs, IA - DCN 08492	NPDES Facility Permit and Fact Sheet for Southwest Iowa Renewable Energy, Council Bluffs, IA - IA0081043.	Permit/ Registration	IA DNR	10/01/2012	IA DNR. 2012. NPDES Permit and Fact Sheet for Southwest Iowa Renewable Energy, Council Bluffs, IA - IA0081043. (October 1).	OCPSF (Organic Chemicals, Plastics and Synthetic Fibers)	22	No	No	08492
10.39	EPA-HQ-OW-2015-0665-0482	Iowa Department of Natural Resources (IA DNR). National Pollutant Discharge Elimination System Facility Permit and Fact Sheet for NPDES IA0000205 - Monsanto Company, Muscatine, IA - DCN 08493	NPDES Facility Permit and Fact Sheet for Monsanto Company, Muscatine, IA - IA0000205.	Permit/ Registration	IA DNR	01/01/2012	IA DNR. 2012. NPDES Permit and Fact Sheet for Monsanto Company, Muscatine, IA - IA0000205. (January 1).	OCPSF (Organic Chemicals, Plastics and Synthetic Fibers)	79	No	No	08493

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10.39	EPA-HQ-OW-2015-0665-0483	Iowa Department of Natural Resources (IA DNR). National Pollutant Discharge Elimination System Facility Permit and Fact Sheet for IA0000256 - Roquette America, Inc., Keokuk, IA - DCN 08494	NPDES Facility Permit and Fact Sheet for Roquette America, Inc., Keokuk, IA - IA0000256.	Permit/ Registration	IA DNR	11/09/2012	IA DNR. 2012. NPDES Permit and Fact Sheet for Roquette America, Inc., Keokuk, IA - IA0000256. (November 9).	OCPSF (Organic Chemicals, Plastics and Synthetic Fibers)	60	No	No	08494
10.39	EPA-HQ-OW-2015-0665-0484	Iowa Department of Natural Resources (IA DNR). National Pollutant Discharge Elimination System Facility Permit and Fact Sheet for IA0081248 - Plymouth Energy, LLC, Merrill, IA - DCN 08495	NPDES Facility Permit and Fact Sheet for Plymouth Energy, LLC., Merrill, IA - IA0081248.	Permit/ Registration	IA DNR	10/01/2013	IA DNR. 2013. NPDES Permit and Fact Sheet for Plymouth Energy, LLC, Merrill, IA - IA0081248. (October 1).	OCPSF (Organic Chemicals, Plastics and Synthetic Fibers)	22	No	No	08495
10.39	EPA-HQ-OW-2015-0665-0485	Iowa Department of Natural Resources (IA DNR). National Pollutant Discharge Elimination System Facility Permit and Fact Sheet for IA0082279 - ADM Bioprocessing, Clinton, IA - DCN 08496	NPDES Facility Permit and Fact Sheet for ADM Bioprocessing, Clinton, IA - IA0082279.	Permit/ Registration	IA DNR	08/01/2014	IA DNR. 2014. NPDES Permit and Fact Sheet for ADM Bioprocessing, Clinton, IA - IA0082279. (August 1).	OCPSF (Organic Chemicals, Plastics and Synthetic Fibers)	11	No	No	08496

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10.39	EPA-HQ-OW-2015-0665-0486	Iowa Department of Natural Resources (IA DNR). National Pollutant Discharge Elimination System Facility Permit and Fact Sheet for IA0052535 - New Haven Chemicals Iowa, LLC, Manly, IA - DCN 08497	NPDES Facility Permit and Fact Sheet for New Haven Chemicals Iowa, LLC, Manly, IA - IA0052535.	Permit/ Registration	IA DNR	02/15/2016	IA DNR. 2016. NPDES Permit and Fact Sheet for New Haven Chemicals Iowa, LLC, Manly, IA - IA0052535. (February 15).	OCPSF (Organic Chemicals, Plastics and Synthetic Fibers)	62	No	No	08497
10.39	EPA-HQ-OW-2015-0665-0487	Nebraska Department of Environmental Quality (NE DEQ). National Pollutant Discharge Elimination System Facility Permit and Fact Sheet for NE0134279 - Cornhusker Energy Lexington, LLC, Lexington, NE - DCN 08498	NPDES Facility Permit and Fact Sheet for Cornhusker Energy Lexington, LLC, Lexington, NE - NE0134279.	Permit/ Registration	NE DEQ	04/01/2011	NE DEQ. 2011. NPDES Permit and Fact Sheet for Cornhusker Energy Lexington, LLC, Lexington, NE - NE0134279. (April 1).	OCPSF (Organic Chemicals, Plastics and Synthetic Fibers)	52	No	No	08498
10.39	EPA-HQ-OW-2015-0665-0488	Nebraska Department of Environmental Quality (NE DEQ). National Pollutant Discharge Elimination System Facility Permit and Fact Sheet for NE0137715 - Green Plains Wood River, Wood River, NE - DCN 08499	NPDES Facility Permit and Fact Sheet for Green Plains Wood River, Wood River, NE - NE0137715.	Permit/ Registration	NE DEQ	07/01/2012	NE DEQ. 2012. NPDES Permit and Fact Sheet for Green Plains Wood River, Wood River, NE - NE0137715. (July 1).	OCPSF (Organic Chemicals, Plastics and Synthetic Fibers)	17	No	No	08499

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10.39	EPA-HQ-OW-2015-0665-0489	Nebraska Department of Environmental Quality (NE DEQ). National Pollutant Discharge Elimination System Facility Permit and Fact Sheet for NE0138045 - Bridgeport Ethanol LLC, Bridgeport, NE - DCN 08500	NPDES Facility Permit and Fact Sheet for Bridgeport Ethanol LLC, Bridgeport, NE - NE0138045.	Permit/ Registration	NE DEQ	04/01/2014	NE DEQ. 2014. NPDES Permit and Fact Sheet for Bridgeport Ethanol LLC, Bridgeport, NE - NE0138045. (April 1).	OCPSF (Organic Chemicals, Plastics and Synthetic Fibers)	37	No	No	08500
10.39	EPA-HQ-OW-2015-0665-0490	Nebraska Department of Environmental Quality (NE DEQ). National Pollutant Discharge Elimination System Facility Permit and Fact Sheet for NE0131334 - Cargill Corn Milling, Blair, NE - DCN 08501	NPDES Facility Permit and Fact Sheet for Cargill Corn Milling, Blair, NE - NE0131334.	Permit/ Registration	NE DEQ	01/01/2015	NE DEQ. 2015. NPDES Permit and Fact Sheet for Cargill Corn Milling, Blair, NE - NE0131334. (January 1).	OCPSF (Organic Chemicals, Plastics and Synthetic Fibers)	63	No	No	08501
10.39	EPA-HQ-OW-2015-0665-0491	Telephone and Email Communication Between Andrew Parker, Honeywell International, and Kimberly Bartell, ERG. Re: 2014 TRI Nitrate Discharges - DCN 08502	Telephone and email conversation between Andrew Parker, Honeywell International, and Kimberly Bartell, Eastern Research Group, Inc., about 2014 TRI Nitrate Discharges.	Meeting Materials	Parker, A.	03/30/2016	Parker, A. 2016. Communication Between Andrew Parker, Honeywell International, and Kim Bartell, ERG. Re: 2014 TRI Nitrate Discharges. (March 30).	OCPSF (Organic Chemicals, Plastics and Synthetic Fibers)	4	No	No	08502

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10.39	EPA-HQ-OW-2015-0665-0492	Telephone and Email Communication Between Curt Petrosky, Eastman Chemical Co. PA Operations, and Kimberly Bartell & Amie Aguiar, ERG. Re: 2014 TRI Nitrate Discharges - DCN 08503	Telephone and email conversation between Curt Petrosky, Eastman Chemical Co. PA Operations, and Kimberly Bartell & Amie Aguiar, Eastern Research Group, Inc., about 2014 TRI Nitrate Discharges.	Meeting Materials	Petrosky, C.	03/23/2016	Petrosky, C. 2016. Communication Between Curt Petrosky, Eastman Chemical Co. and Kim Bartell & Amie Aguiar, ERG. Re: Nitrate Discharges. (March 23).	OCPSF (Organic Chemicals, Plastics and Synthetic Fibers)	3	No	No	08503
10.39	EPA-HQ-OW-2015-0665-0493	Telephone and Email Communication Between Frenda Smith, Eastman Chemical Co. TN Operations, and Kimberly Bartell, ERG. Re: 2014 TRI Nitrate Discharges - DCN 08504	Telephone and email conversation between Frenda Smith, Eastman Chemical Co. TN Operations, and Kimberly Bartell, Eastern Research Group, Inc., about 2014 TRI Nitrate Discharges.	Meeting Materials	Smith, F.	03/21/2016	Smith, F. 2016. Communication Between Frenda Smith, Eastman Chemical Co., and Kim Bartell, ERG. Re: 2014 TRI Nitrate Discharges. (March 21).	OCPSF (Organic Chemicals, Plastics and Synthetic Fibers)	3	No	No	08504
10.39	EPA-HQ-OW-2015-0665-0494	Texas Commission on Environmental Quality (TCEQ). National Pollutant Discharge Elimination System Facility Permit and Fact Sheet for TX0005061 - Goodyear Tire & Rubber Co., Beaumont, TX - DCN 08505	NPDES Facility Permit and Fact Sheet for Goodyear Tire & Rubber Co., Beaumont, TX - TX0005061.	Permit/ Registration	TCEQ	11/28/2007	TCEQ. 2007. NPDES Permit and Fact Sheet for Goodyear Tire & Rubber Co., Beaumont, TX - TX0005061. (November 28).	OCPSF (Organic Chemicals, Plastics and Synthetic Fibers)	83	No	No	08505

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10.39	EPA-HQ-OW-2015-0665-0495	Texas Commission on Environmental Quality (TCEQ). National Pollutant Discharge Elimination System Facility Permit and Fact Sheet for TX0006084 - Rohmax USA, , Deer Park, TX - DCN 08506	NPDES Facility Permit and Fact Sheet for Goodyear Tire & Rubber Co., Rohmax USA, Deer Park, TX - TX0006084.	Permit/ Registration	TCEQ	12/18/2009	TCEQ. 2009. NPDES Permit and Fact Sheet: for Rohmax USA, , Deer Park, TX - TX0006084. (December 18).	OCPSF (Organic Chemicals, Plastics and Synthetic Fibers)	161	No	No	08506
10.39	EPA-HQ-OW-2015-0665-0496	Texas Commission on Environmental Quality (TCEQ). National Pollutant Discharge Elimination System Facility Permit and Fact Sheet for TX0077577 - Ineos Nitriles USA LLC. Green Lake Plant, Port Lavaca, TX - DCN 08507	NPDES Facility Permit and Fact Sheet for Ineos Nitriles USA LLC. Green Lake Plant, Port Lavaca, TX - TX0077577.	Permit/ Registration	TCEQ	08/25/2015	TCEQ. 2015. NPDES Permit and Fact Sheet for Ineos Nitriles USA LLC. Green Lake Plant, Port Lavaca, TX - TX0077577. (August 25).	OCPSF (Organic Chemicals, Plastics and Synthetic Fibers)	81	No	No	08507
10.39	EPA-HQ-OW-2015-0665-0497	Texas Commission on Environmental Quality (TCEQ). National Pollutant Discharge Elimination System Facility Permit and Fact Sheet for TX0006017 - Oxea Bay City Plant, Bay City, TX - DCN 08508	NPDES Facility Permit and Fact Sheet for Oxea Bay City Plant, Bay City, TX - TX0006017.	Permit/ Registration	TCEQ	01/13/2016	TCEQ. 2016. NPDES Permit and Fact Sheet for Oxea Bay City Plant, Bay City, TX - TX0006017. (January 13).	OCPSF (Organic Chemicals, Plastics and Synthetic Fibers)	71	No	No	08508

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10.39	EPA-HQ-OW-2015-0665-0498	Texas Commission on Environmental Quality (TCEQ). National Pollutant Discharge Elimination System Facility Permit and Fact Sheet for TX0003531 - Equistar Chemicals Channelview Complex, Houston, TX - DCN 08509	NPDES Facility Permit and Fact Sheet for Equistar Chemicals Channelview Complex, Houston, TX - TX0003531.	Permit/ Registration	TCEQ	04/13/2016	TCEQ. 2016. NPDES Permit and Fact Sheet for Equistar Chemicals Channelview Complex, Houston, TX - TX0003531. (April 13).	OCPSF (Organic Chemicals, Plastics and Synthetic Fibers)	119	No	No	08509
10.39	EPA-HQ-OW-2015-0665-0499	Telephone and Email Communication Between Greg Twait, Invista Sarl Camden May Plant, and Amie Aguiar, ERG. Re: 2014 TRI Nitrate Discharges - DCN 08510	Telephone and email conversation between Greg Twait, Invista Sarl Camden May Plant, and Amie Aguiar, ERG. Re: 2014 TRI Nitrate Discharges.	Meeting Materials	Twait, G.	03/21/2016	Twait, G. 2016. Communication Between Greg Twait, Invista Sarl Camden May Plant, and Amie Aguiar, ERG. Re: 2014 TRI Nitrate Discharges. (March 21).	OCPSF (Organic Chemicals, Plastics and Synthetic Fibers)	2	No	No	08510
10.39	EPA-HQ-OW-2015-0665-0500	Table of POTW Removals - DCN 08511	TRI POTW Removals Used in the DMR Loading Tool n 2016.	Data	U.S. EPA	01/01/2016	U.S. EPA. 2016. Table of POTW Removals. Washington, D.C. Available online at: https://cfpub.epa.gov/dmr/.	OCPSF (Organic Chemicals, Plastics and Synthetic Fibers)	1	No	No	08511

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10.39	EPA-HQ-OW-2015-0665-0501	National Recommended Water Quality Criteria - Aquatic Life Criteria Table - DCN 08512	U.S. EPA national recommended water quality criteria, specifically for aquatic life. Aquatic life criteria for toxic chemicals are the highest concentration of specific pollutants or parameter in water that are not expected to pose a significant risk to the majority of species in a given environment.	Publication; US EPA	U.S. EPA	07/28/2016	U.S. EPA. 2016. National Recommended Water Quality Criteria - Aquatic Life Criteria Table. Washington, D.C. (July).	OCPSF (Organic Chemicals, Plastics and Synthetic Fibers)	10	No	No	08512
10.39	EPA-HQ-OW-2015-0665-0502	Organic Chemicals, Plastics and Synthetic Fibers Effluent Guidelines Webpage - DCN 08513	The OCPSF Effluent Guidelines and Standards are incorporated into NPDES (National Pollutant Discharge Elimination System) permits for direct dischargers, and permits or other control mechanisms for indirect dischargers (see Pretreatment Program).	Publication; US EPA	U.S. EPA	02/01/2016	U.S. EPA. 2016. Organic Chemicals, Plastics and Synthetic Fibers Effluent Guidelines. Washington, D.C.	OCPSF (Organic Chemicals, Plastics and Synthetic Fibers)	4	No	No	08513
10.39	EPA-HQ-OW-2015-0665-0503	Table of Regulated Drinking Water Contaminants - DCN 08514	U.S. EPA Table of Regulated Drinking Water Contaminants.	Publication; US EPA	U.S. EPA	07/15/2016	U.S. EPA. 2016. Table of Regulated Drinking Water Contaminants. Washington, D.C. (July).	OCPSF (Organic Chemicals, Plastics and Synthetic Fibers)	19	No	No	08514

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10.39	EPA-HQ-OW-2015-0665-0504	West Virginia Department of Environmental Protection (WV DEP). National Pollutant Discharge Elimination System Facility Permit and Fact Sheet for WV0005169 - Bayer Material Science, New Martinsville, WV - DCN 08515	NPDES Facility Permit and Fact Sheet for Bayer Material Science, New Martinsville, WV - WV0005169.	Permit/ Registration	WV DEP	01/25/2013	WV DEP. 2013. NPDES Permit and Fact Sheet for Bayer Material Science, New Martinsville, WV - WV0005169. (January 25).	OCPSF (Organic Chemicals, Plastics and Synthetic Fibers)	288	No	No	08515
10.39	EPA-HQ-OW-2015-0665-0505	West Virginia Department of Environmental Protection (WV DEP). National Pollutant Discharge Elimination System Facility Permit and Fact Sheet for WV0000841 - Sabic Innovative Plastics US LLC Washington, WV - DCN 08516	NPDES Facility Permit and Fact Sheet for Sabic Innovative Plastics US LLC., Washington, WV - WV0000841.	Permit/ Registration	WV DEP	06/29/2013	WV DEP. 2013. NPDES Permit and Fact Sheet for Sabic Innovative Plastics US LLC., Washington, WV - WV0000841. (June 29).	OCPSF (Organic Chemicals, Plastics and Synthetic Fibers)	169	No	No	08516
10.39	EPA-HQ-OW-2015-0665-0506	West Virginia Department of Environmental Protection (WV DEP). National Pollutant Discharge Elimination System Facility Permit and Fact Sheet for WV0000787 - Cytec Industries Inc., Belmont, WV - DCN 08517	NPDES Facility Permit and Fact Sheet for Cytec Industries Inc., Belmont, WV - WV0000787.	Permit/ Registration	WV DEP	09/28/2015	WV DEP. 2015. NPDES Permit and Fact Sheet for Cytec Industries Inc., Belmont, WV - WV0000787. (September 28).	OCPSF (Organic Chemicals, Plastics and Synthetic Fibers)	99	No	No	08517

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10.39	EPA-HQ-OW-2015-0665-0507	West Virginia Department of Environmental Protection (WV DEP). National Pollutant Discharge Elimination System Facility Permit and Fact Sheet for WV0116416 - Kureha PGA, LLC., Belle, WV - DCN 08518	NPDES Permit and Fact Sheet for Kureha PGA, LLC., Belle, WV - WV0116416.	Permit/ Registration	WV DEP	09/29/2015	WV DEP. 2015. NPDES Permit and Fact Sheet for Kureha PGA, LLC., Belle, WV - WV0116416. (September 29).	OCPSF (Organic Chemicals, Plastics and Synthetic Fibers)	30	No	No	08518
10.39	EPA-HQ-OW-2015-0665-0508	Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses - DCN 08519	Data on toxicity to aquatic plants are examined to determine whether plants are likely to be unacceptably affected by concentrations that should not cause unacceptable effects on animals. Data on bioaccumulation by aquatic organisms are used to determine if residues might subject edible species to restrictions by the U.S. Food and Drug Administration or if such residues might harm some wildlife consumers of aquatic life.	Publication; US EPA	U.S. EPA	01/01/1985	U.S. EPA. 1985. Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses.	OCPSF (Organic Chemicals, Plastics and Synthetic Fibers)	59	No	No	08519
10.42	EPA-HQ-OW-2015-0665-0380	CAS registry and CAS registry number FAQs - DCN 08384	CAS registry frequently asked questions.	Fact/Data Sheet	CAS	10/28/2016	Chemical Abstracts Service. (2016). CAS registry and FAQs. Available online at: https://www.cas.org/content/chemical-substances/faqs.	Pesticide Chemicals Manufacturing, Formulation and Repackaging,	3	No	No	08384

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10.42	EPA-HQ-OW-2015-0665-0381	TRI and DMR Data Review for Pesticide Active Ingredients - DCN 08385	Summary of 2010 through 2015 Toxics Release Inventory and Discharge Monitoring Report data for Pesticides Active Ingredients reviewed for the ELG Planning Review Report Supporting the Final 2016 ELG Plan.	Data	ERG	11/01/2016	ERG. (2016). Eastern Research Group, Inc. TRI and DMR Data Review for Pesticide Active Ingredients. Chantilly, VA. (November).	Pesticide Chemicals Manufacturing, Formulation and Repackaging,	0	No	No	08385
10.42	EPA-HQ-OW-2015-0665-0382	Hazardous Substances Data Bank (HSDB): A Toxicology Data Network (TOXNET) Database - DCN 08386	Toxicology database that focuses on the toxicology of potentially hazardous chemicals. Provides information on human exposure, industrial hygiene, emergency handling procedures, environmental fate, regulatory requirements, nanomaterials, and related areas.	Data	HSDB	10/17/2016	HSDB. (2016). Hazardous Substances Data Bank: TOXNET Database. (October). Available online at: https://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB.	Pesticide Chemicals Manufacturing, Formulation and Repackaging,	80	No	No	08386
10.42	EPA-HQ-OW-2015-0665-0383	Pesticide Action Network (PAN) Pesticide Database - DCN 08387	Toxicity and regulatory information for pesticides.	Data	Kegley, S. E., et al.	12/02/2016	Kegley, S. E., et al. (2016). Pesticide Action Network, North America. PAN Pesticide Database. Available online at: http://www.pesticideinfo.org.	Pesticide Chemicals Manufacturing, Formulation and Repackaging,	1	No	No	08387

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10.42	EPA-HQ-OW-2015-0665-0384	PubChem Compound Database - DCN 08388	PubChem Compound Database compiled by the National Center for Biotechnology Information. Validated chemical depiction information that are pre-clustered and cross-referenced by identity and similarity groups.	Data	NCBI	12/02/2016	NCBI. (2016). National Center for Biotechnology Information. PubChem Compound Database. Available online at: https://www.ncbi.nlm.nih.gov/pccompound.	Pesticide Chemicals Manufacturing, Formulation and Repackaging	1	No	No	08388
10.42	EPA-HQ-OW-2015-0665-0385	Email Communication Between Claudia Niess, U.S. EPA Office of Pesticide Programs, and Emily Trentacoste, U.S. EPA Office of Water. Re: Another Pesticide Question - DCN 08389	Email Communication Between Claudia Niess, U.S. EPA Office of Pesticide Programs, and Emily Trentacoste, U.S. EPA Office of Water, discussing pesticide active ingredient use.	E-mail	Niess, Claudia	12/28/2016	Niess, C. (2016). Email Communication Between Claudia Niess, EPA OPP, and Emily Trentacoste, EPA OW. Re: Another Pesticide Question. (Dec 28).	Pesticide Chemicals Manufacturing, Formulation and Repackaging	2	No	No	08389
10.42	EPA-HQ-OW-2015-0665-0386	Chemical Aquatic Fate and Effects (CAFE) Database - DCN 08390	In response to increasing need of rapid and accurate environmental assessments of chemical spills, the Emergency Response Division (ERD) of NOAA's Office of Response and Restoration developed the CAFE Database. This user-friendly computer software system serves as a tool to aid responders in their assessment of the environmental impacts that may arise from chemical spills in situations where critical decisions need to be made within a few hours after a spill occurs.	Data	NOAA	05/01/2016	NOAA. (2016). Office of Response and Restoration, Emergency Response Division. CAFE Database. Version 1.2 [Computer Software].	Pesticide Chemicals Manufacturing, Formulation and Repackaging	2	No	No	08390

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10.42	EPA-HQ-OW-2015-0665-0387	Chemical Aquatic Fate and Effects (CAFE) Database: User Manual - DCN 08391	User guide to the CAFE database, a user-friendly computer software system serves as a tool to aid responders in their assessment of the environmental impacts that may arise from chemical spills in situations where critical decisions need to be made within a few hours after a spill occurs. Developed by the Emergency Response Division (ERD) of NOAA's Office of Response and Restoration.	Fact/Data Sheet	NOAA	05/01/2016	NOAA. (2016). Chemical Aquatic Fate and Effects (CAFE) Database: User Manual. Version 1.2. Seattle, WA. (May).	Pesticide Chemicals Manufacturing, Formulation and Repackaging	94	No	No	08391
10.42	EPA-HQ-OW-2015-0665-0388	Pesticide chemical search: Conventional, antimicrobial and biopesticide active ingredients - DCN 08392	Pesticide chemical search for conventional, antimicrobial, and biopesticide active ingredients from the Office of Pesticide Programs.	Data	OPP	10/01/2016	OPP. (2016). Office of Pesticide Programs. Pesticide chemical search: Conventional, antimicrobial and biopesticide active ingredients.	Pesticide Chemicals Manufacturing, Formulation and Repackaging	1	No	No	08392
10.42	EPA-HQ-OW-2015-0665-0389	Office of Pesticides Programs Information Network- DCN 08393	Website for Office of Pesticides resources	Data	OPPIN	10/01/2016	OPPIN. (2016). Office of Pesticides Programs Information Network. Available online at: https://www.epa.gov/pesticides.	Pesticide Chemicals Manufacturing, Formulation and Repackaging	3	No	No	08393

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10.42	EPA-HQ-OW-2015-0665-0390	Email Communication Between Steve Robbins, U.S. EPA Office of Pesticide Programs, and Emily Trentacoste, U.S. EPA Office of Water. Re: PRISM information for OW - DCN 08394	Email communication between Steve Robbins, U.S. EPA Office of Pesticide Programs, and Emily Trentacoste, U.S. EPA Office of Water about PRISM information for OW.	E-mail	Robbins, Steve	11/16/2016	Robbins, S. (2016). Email Communication Between Steve Robbins, EPA OPP, and Emily Trentacoste, U.S. EPA OW. Re: PRISM information for OW. (Nov 16).	Pesticide Chemicals Manufacturing, Formulation and Repackaging	1	No	No	08394
10.42	EPA-HQ-OW-2015-0665-0391	Telephone Communication Between Chuck Ruple, U.S. EPA Region 6 Pesticides Section, and Emily Trentacoste, U.S. EPA Office of Water. Re: EPA Section Seven Tracking System - DCN 08395	Telephone communication between Chuck Ruple, U.S. EPA Region 6 Pesticides Section, and Emily Trentacoste, U.S. EPA Office of Water about the Section Seven Tracking System.	Meeting Materials	Ruple, Chuck	07/07/2016	Ruple, C. (2016). Telephone communication between Chuck Ruple, EPA Region 6, and Emily Trentacoste, EPA OW. Re: Using PRISM-SSTS. (June 30).	Pesticide Chemicals Manufacturing, Formulation and Repackaging	1	No	No	08395
10.42	EPA-HQ-OW-2015-0665-0392	Final Development Document for Effluent Limitations Guidelines, Pretreatment Standards, and New Source Performance Standards for the Pesticide Chemicals Point Source Category - DCN 08396	Final development document for the Pesticide Chemicals ELGs.	Publication; USEPA	U.S. EPA	09/01/1993	U.S. EPA. (1993). Development Document for ELGs for the Pesticide Chemicals Point Source Category. (Sept). EPA-821-R-93-016.	Pesticide Chemicals Manufacturing, Formulation and Repackaging	385	No	No	08396

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10.42	EPA-HQ-OW-2015-0665-0393	Federal Register Notice: Pesticide Chemicals Category Effluent Limitations Guidelines, Pretreatment Standards, and New Source Performance Standards - DCN 08397	Pesticide Chemicals Manufacturing Point Source Category ELGs 1993 FR Notice, 58 FR 50638.	Publication; USEPA	U.S. EPA	09/28/1993	U.S. EPA. (1993). FR Notice: Pesticide Chemicals Category ELGs. (Sept).	Pesticide Chemicals Manufacturing, Formulation and Repackaging	63	No	No	08397
10.42	EPA-HQ-OW-2015-0665-0394	Federal Register Notice: Pesticide Chemicals Category, Formulating, Packaging, and Repackaging Effluent Limitations Guidelines, Pretreatment Standards, and New Source Performance Standards - DCN 08398	Pesticide Chemicals Manufacturing Point Source Category ELGs 1996 FR Notice, 61 FR 57518.	Publication; USEPA	U.S. EPA	11/06/1996	U.S. EPA. (1996). FR Notice: Pesticide Chemicals Category ELGs. (Nov).	Pesticide Chemicals Manufacturing, Formulation and Repackaging	49	No	No	08398
10.42	EPA-HQ-OW-2015-0665-0395	Sustainable Futures/P2 Framework Manual. Chapter 5: Estimating Physical/Chemical and Environmental Fate Properties with EPI Suite - DCN 08399	Estimation Programs Interface (EPI) Suite guidance.	Publication; USEPA	U.S. EPA	01/01/2012	U.S. EPA. (2012). Sustainable Futures/P2 Framework Manual. Chapter 5: Estimating Properties with EPI Suite. EPA-748-B12-001.	Pesticide Chemicals Manufacturing, Formulation and Repackaging	22	No	No	08399

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10.42	EPA-HQ-OW-2015-0665-0396	Pesticide Registration Manual - DCN 08400	Manual describes EPA's review and decision-making process for registering a pesticide product and its use.	Publication; USEPA	U.S. EPA	10/01/2016	U.S. EPA. (2016). Pesticide Registration Manual. Available online at: https://www.epa.gov/pesticide-registration/pesticide-registration-manual.	Pesticide Chemicals Manufacturing, Formulation and Repackaging	4	No	No	08400
10.42	EPA-HQ-OW-2015-0665-0397	Pesticide Registration Information System (PRISM) - DCN 08401	PRISM provides a centralized source of information on all registered pesticide products, including chemical composition, toxicity, name and address of registrant, brand names, registration actions, and related data.	Data	U.S. EPA	10/01/2016	U.S. EPA. (2016). Pesticide Registration Information System (PRISM). Non-CBI information available online.	Pesticide Chemicals Manufacturing, Formulation and Repackaging	6	No	No	08401
10.42	EPA-HQ-OW-2015-0665-0398	Section Seven Tracking System (SSTS) database - DCN 08402	Registration and reporting system for pesticide establishments.	Data	U.S. EPA	10/01/2016	U.S. EPA. (2016). Section Seven Tracking System (SSTS) database. Non-CBI information available online.	Pesticide Chemicals Manufacturing, Formulation and Repackaging	4	No	No	08402

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10.49	EPA-HQ-OW-2015-0665-0446	Mathematical modeling of biological selenium removal from flue gas desulfurization (FGD) wastewater treatment - DCN 08455	This paper presents full-scale flue gas desulfurization wastewater treatment plant data on selenium concentration and speciation, and proposes a model that addresses the reductive competition between denitrifies and Selenium Reducing Bacteria.	Publication; Copyrighted Materials	Andalib, M.	01/01/2016	Andalib, et al. 2016. Mathematical modeling of biological selenium removal from flue gas desulfurization (FGD) wastewater treatment. WEFTEC.	Pulp, Paper, and Paperboard	21	No	Yes	08455
10.49	EPA-HQ-OW-2015-0665-0447	Selenium Treatment System Evaluation Report - DCN 08456	Facility completed the construction of a selenium treatment system in June 2011. This paper presents selenium treatment system data.	Publication	Coal Mac, Inc.	06/01/2011	Coal Mac, Inc. 2011. Selenium treatment system evaluation report.	Pulp, Paper, and Paperboard	3	No	No	08456
10.49	EPA-HQ-OW-2015-0665-0448	Connecticut Department of Energy & Environmental Protection (CT DEEP). National Pollutant Discharge Elimination System Facility Permit and Fact Sheet for NPDES CT0000434 - Ahlstrom Nonwovens, Windsor Locks, CT - DCN 08457	NPDES Facility Permit and Fact Sheet for Ahlstrom Nonwovens, Windsor Locks, CT - CT0000434.	Publication; Copyrighted Materials	CT DEEP	09/24/2009	CT DEEP. 2009. NPDES Permit and Fact Sheet for Ahlstrom Nonwovens, Windsor Locks, CT - CT0000434. (September 24).	Pulp, Paper, and Paperboard	45	No	Yes	08457

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10.49	EPA-HQ-OW-2015-0665-0449	Connecticut Department of Energy & Environmental Protection (CT DEEP). National Pollutant Discharge Elimination System Facility Permit and Fact Sheet for NPDES CT0026476 - Algonquin Power Cogeneration Facility, Windsor Locks, CT - DCN 08458	NPDES Facility Permit and Fact Sheet for Algonquin Power Cogeneration Facility, Windsor Locks, CT - CT0026476.	Permit, Registration	CT DEEP	01/27/2011	CT DEEP. 2011. NPDES Permit and Fact Sheet for Algonquin Power Cogeneration Facility, Windsor Locks, CT - CT0026476. (January 27).	Pulp, Paper, and Paperboard	36	No	No	08458
10.49	EPA-HQ-OW-2015-0665-0450	Connecticut Department of Energy & Environmental Protection (CT DEEP). National Pollutant Discharge Elimination System Facility Permit and Fact Sheet for NPDES CT0003212 - Kimberly-Clark Corporation, New Milford, CT - DCN 08459	NPDES Facility Permit and Fact Sheet for Kimberly-Clark Corporation, New Milford, CT - CT0003212.	Permit, Registration	CT DEEP	02/16/2011	CT DEEP. 2011. NPDES Permit and Fact Sheet for Kimberly-Clark, New Milford, CT - CT0003212. (February 16).	Pulp, Paper, and Paperboard	22	No	No	08459
10.49	EPA-HQ-OW-2015-0665-0451	Development and Implementation of a Novel Sulfur Removal Process from H2S Containing Wastewaters - DCN 08460	A novel dissolved sulfide removal wastewater treatment process was developed and implemented in a membrane bioreactor (MBR) treating anaerobically pre-treated industrial (pulp and paper) wastewater at the Gippsland Water Factory.	Publication	Daigger, G. T., et al.	01/01/2013	Daigger, G. T., et al. 2013. Development and Implementation of a Novel Sulfur Removal Process from H2S Containing Wastewaters. WEFTEC.	Pulp, Paper, and Paperboard	13	No	No	08460

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10.49	EPA-HQ-OW-2015-0665-0452	Pilot Study of Pulp & Paper Mill Effluent Treatment with MBR-RO System - DCN 08461	A paper mill in the southwestern United States currently discharges all of its wastewater to a municipal wastewater plant for treatment. A pilot study was conducted for two months using MBR and RO directly treating the wastewater from the paper mill.	Publication; Copyrighted Materials	Dhagumudi, V.	01/01/2012	Dhagumudi, Vetrivel. 2012. Pilot Study of Pulp & Paper Mill Effluent Treatment with MBR-RO System. WEFTEC.	Pulp, Paper, and Paperboard	13	No	Yes	08461
10.49	EPA-HQ-OW-2015-0665-1054	Continued Preliminary Category Review – Facility Data Review and Calculations for Point Source Category 430 – Pulp and Paper - DCN 08462	Facility Data Review and Calculations for Point Source Category 430 – Pulp and Paper for the ELG Planning Review Report Supporting the Final 2016 ELG Plan.	Data	ERG	09/01/2016	ERG. 2016. Continued Preliminary Category Review – Facility Data Review and Calculations for PSC 430 – Pulp and Paper. Chantilly, VA. (Sept).	Pulp, Paper, and Paperboard	0	No	No	08462
10.49	EPA-HQ-OW-2015-0665-0453	Pilot Testing of Selenium Removal in a Surface Coal Mine Water Containing High Nitrate and Selenium Concentrations - DCN 08463	Pilot testing of an anoxic fluidized bed reactor (FBR) technology for selenium (Se) removal from runoff water at Teck Coal Limited's Line Creek mining operation was conducted in 2011. Based on pilot testing results, a subsequent conceptual treatment alternatives evaluation identified FBR based treatment to be the most feasible and cost effective technology for full scale application.	Publication; Copyrighted Materials	Gay, M., et al.	01/01/2012	Gay, M., et al. 2012. Pilot Testing of Selenium Removal in a Surface Coal Mine Water Containing High Nitrate and Selenium Concentrations. WEFTEC.	Pulp, Paper, and Paperboard	18	No	Yes	08463

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10.49	EPA-HQ-OW-2015-0665-0454	Selenium Recovery for Beneficial Reuse from Zinc Smelting Processing at Low pH Conditions - DCN 08464	Summary of a research project to validate a selenium recovery process using vortex based anti-fouling membrane technology.	Publication; Copyrighted Materials	Kim, J.K., et al.	01/01/2013	Kim, J.K., et al. 2013. Selenium Recovery for Beneficial Reuse from Zinc Smelting Processing at Low pH Conditions.	Pulp, Paper, and Paperboard	11	No	Yes	08464
10.49	EPA-HQ-OW-2015-0665-0455	Full Scale Application of Ozone for Bulking Control at a Pulp &Paper Facility - DCN 08465	This paper is focused on the application of ozone for bulking control at full scale in a pulp and paper facility which treats about 350 m3/hr of flow. The goal of ozonation was to reduce and to reliably maintain DSVI (ml/g) at target values that enable good settling.	Publication; Copyrighted Materials	Larrea, A., et al.	01/01/2013	Larrea, A., et al. 2013. Full Scale Application of Ozone for Bulking Control at a Pulp &Paper Facility. WEFTEC.	Pulp, Paper, and Paperboard	10	No	Yes	08465
10.49	EPA-HQ-OW-2015-0665-0456	Piloting Conventional and Emerging Industrial Wastewater Treatment Technologies for the Treatment of Oil Sands Process Affected Water - DCN 08466	In 2010-2011, Suncor Energy piloted several conventional and emerging industrial wastewater treatment technologies on tailings water. Among the technologies examined were Dissolved Air Floatation, Ultrafiltration (UF), Reverse-Osmosis (RO), Advanced Oxidation (Ozone-Peroxide based), suspended-growth biological systems and attached-growth biological systems. This paper summarizes the performance and challenges observed over the course of this pilot.	Publication	Mah, R. et al.	01/01/2011	Mah, R. et al. 2011. Piloting conventional and emerging treatment technologies for the treatment of oil sands process affected water.	Pulp, Paper, and Paperboard	16	No	No	08466

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10.49	EPA-HQ-OW-2015-0665-0457	Bench- and Pilot-Scale Testing of Ion Exchange and Zero Valent Iron Technologies for Selenium Removal from a Surface Coal Mine Run-Off Water - DCN 08467	Bench- and pilot-scale testing was conducted for removal of selenium from runoff water at a surface coal mining operation in 2011. The study focused on two technologies for selenium removal: ion exchange (IX) and zero-valent iron (ZVI).	Publication; Copyrighted Materials	Martins, K. et al.	01/01/2012	Martins, et al. 2012. Testing of ion exchange and zero valent iron technologies for selenium removal from a surface coal mine run-off water.	Pulp, Paper, and Paperboard	21	No	Yes	08467
10.49	EPA-HQ-OW-2015-0665-0458	Telephone and Email Communication Between Art Mauger, Connecticut Department of Energy & Environmental Protection, and Kimberly Bartell, ERG. Re: Pulp and Paper Mill Permitting Practices in Connecticut - DCN 08468	Telephone and email conversation between Art Mauger, Connecticut Department of Energy & Environmental Protection, and Kimberly Bartell, Eastern Research Group, Inc., about Pulp and Paper Mill Permitting Practices in Connecticut.	Meeting Materials	Mauger, A.	03/28/2016	Mauger, A. 2016. Communication Between Art Mauger, CT DEEP, and Kim Bartell, ERG. Re: Pulp Mill Permitting Practices in Connecticut. (March 28).	Pulp, Paper, and Paperboard	3	No	No	08468
10.49	EPA-HQ-OW-2015-0665-0459	Selenium Removal from a Refinery Wastewater: Integrated Approach from Source Control to Wastewater Treatment - DCN 08469	This paper discusses a study conducted to identify main sources of selenium in the process waste streams and lab tests to identify the most feasible treatment technology to reduce selenium.	Publication	Mauro, M. et al.	01/01/2013	Mauro, et al. 2013. Selenium removal from a refinery wastewater: Integrated approach from source control to wastewater treatment. CH2M HILL.	Pulp, Paper, and Paperboard	18	No	No	08469

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10.49	EPA-HQ-OW-2015-0665-0460	Selenium Removal from Refinery Wastewater via Iron Co-Precipitation in a Mobile Clarifier - DCN 08470	Paper discusses a variety of technologies for both point source and total plant effluent treatment to more reliably and consistently meet selenium discharge requirements.	Publication; Copyrighted Materials	McCloskey and Jettinghoff	01/01/2009	McCloskey, C. and T. Jettinghoff. 2009. Selenium removal from refinery wastewater via iron co-precipitation in a mobile clarifier.	Pulp, Paper, and Paperboard	7	No	Yes	08470
10.49	EPA-HQ-OW-2015-0665-0471	National Council for Air and Stream Improvement, Inc. Letter from Paul Wiegand, NCASI, to William Swietlik, U.S. EPA, and Kimberly Bartell, ERG. Re: Nutrients in Pulp and Paper Mill Treated Effluents - DCN 08471	Letter from Paul Wiegand, National Council for Air and Stream Improvement, Inc. to William Swietlik, U.S. EPA, and Kimberly Bartell, ERG, about nutrients in pulp and paper mill treated effluents.	Publication; Copyrighted Materials	NCASI	12/22/2016	NCASI. 2016. Letter from Paul Wiegand, NCASI, to Bill Swietlik, U.S. EPA, and Kim Bartell, ERG. RE: Nutrients in Treated Effluents. (December 22).	Pulp, Paper, and Paperboard	250	No	Yes	08471
10.49	EPA-HQ-OW-2015-0665-0472	National Council for Air and Stream Improvement, Inc. Letter from Diana Cook, NCASI, to William Swietlik, U.S. EPA. Re: Manganese, Cadmium, and Selenium in Pulp and Paper Mill Treated Effluents - DCN 08472	Letter from Diana Cook, National Council for Air and Stream Improvement, Inc. to William Swietlik, U.S. EPA, and Kimberly Bartell, ERG, about manganese, cadmium, and selenium in pulp and paper mill treated effluents.	Memorandum	NCASI	03/28/2017	NCASI. 2017. Letter from Diana Cook, NCASI, to Bill Swietlik, U.S. EPA. RE: Manganese, Cadmium, and Selenium in Treated Effluents. (March 28).	Pulp, Paper, and Paperboard	12	No	No	08472

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10.49	EPA-HQ-OW-2015-0665-0461	Strong Enough? Piloting Aerobic vs. Anaerobic Treatment for Food and Beverage Wastewater - DCN 08473	Paper discusses pilot testing conducted to determine the most cost effected treatment scheme to treat wastewater from a food and beverage manufacturer prior to discharge to a nearby receiving stream.	Publication; Copyrighted Materials	Riedel, D., et al.	01/01/2015	Riedel, et al. 2015. Strong enough? Piloting aerobic vs. anaerobic treatment for food and beverage wastewater. WEFTEC.	Pulp, Paper, and Paperboard	15	No	Yes	08473
10.49	EPA-HQ-OW-2015-0665-0462	Telephone and Email Communication Between Jerry Schwartz and Paul Wiegand, American Forest and Paper Association and National Council for Air and Stream Improvement, Inc. and Kimberly Bartell, ERG. Re: 2014 TRI Pulp and Paper Dischargers - DCN 08474	Telephone and email conversation between Jerry Schwartz and Paul Wiegand, American Forest and Paper Association and National Council for Air and Stream Improvement, Inc. and Kimberly Bartell, Eastern Research Group, Inc. about 2014 TRI Pulp and Paper Dischargers.	Meeting Materials	Schwartz & Wiegand	02/24/2016	Schwartz, J. & Wiegand, P. 2016. Communication Between Jerry Schwartz and Paul Wiegand, AF&PA and NCASI and Kim Bartell, ERG. Re: 2014 TRI. (Feb).	Pulp, Paper, and Paperboard	39	No	No	08474
10.49	EPA-HQ-OW-2015-0665-0463	Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Pulp, Paper and Paperboard and the Builders Paper and Board Mills Point Source Categories - DCN 08475	Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Pulp, Paper and Paperboard and the Builders Paper and Board Mills Point Source Categories.	Publication; USEPA	U.S. EPA	12/01/1980	U.S. EPA. 1980. TDD for Proposed ELGs for the Pulp, Paper and Paperboard and the Builders Paper and Board Mills PSCs. Washington, D.C. (Dec).	Pulp, Paper, and Paperboard	660	No	No	08475

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10.49	EPA-HQ-OW-2015-0665-0464	Changes to the TRI List Of Toxic Chemicals - DCN 08476	Chemical deletions and modifications to the TRI list of toxic chemicals in 2015.	Publication; USEPA	U.S. EPA	12/01/2015	U.S. EPA. 2015. Changes To The TRI List Of Toxic Chemicals. Toxics Release Inventory Program. Washington, D.C. (December 1).	Pulp, Paper, and Paperboard	13	No	No	08476
10.49	EPA-HQ-OW-2015-0665-0465	Fluidized Bed Reactor Technology: Implementation and Operation for Industrial Contaminated Water Treatment - DCN 08477	Paper summarizes case studies demonstrating the efficacy of the fluidized bed reactor technology on various contaminated wastewater streams.	Publication; Copyrighted Materials	Webster, T., et al	01/01/2012	Webster, T. et al. 2012. Fluidized bed bioreactor technology: Implementation and operation for industrial contaminated water treatment. WEFTEC.	Pulp, Paper, and Paperboard	12	No	Yes	08477
10.49	EPA-HQ-OW-2015-0665-0466	Wisconsin Department of Natural Resources (WI DNR). National Pollutant Discharge Elimination System Facility Permit and Fact Sheet for NPDES WI0037991 - Stora Enso North America, Wisconsin Rapids, WI - DCN 08478	NPDES Facility Permit and Fact Sheet for Stora Enso North America, Wisconsin Rapids, WI - WI0037991.	Permit, Registration	WI DNR	10/01/2010	WI DNR. 2010. NPDES Permit and Fact Sheet for Stora Enso North America, Wisconsin Rapids, WI - WI0037991. (October 1).	Pulp, Paper, and Paperboard	156	No	No	08478

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10.49	EPA-HQ-OW-2015-0665-0467	Wisconsin Department of Natural Resources (WI DNR). National Pollutant Discharge Elimination System Facility Permit and Fact Sheet for NPDES WI0002810 - Packaging Corp of America, Tomahawk, WI - DCN 08479	NPDES Facility Permit and Fact Sheet for Packaging Corp of America, Tomahawk, WI - WI0002810.	Permit, Registration	WI DNR	04/01/2010	WI DNR. 2010. NPDES Permit and Fact Sheet for Packaging Corp of America, Tomahawk, WI - WI0002810. (April 1).	Pulp, Paper, and Paperboard	91	No	No	08479
10.49	EPA-HQ-OW-2015-0665-0468	Wisconsin Department of Natural Resources (WI DNR). National Pollutant Discharge Elimination System Facility Permit and Fact Sheet for NPDES WI0003620 - Domtar, Point Edwards, WI - DCN 08480	NPDES Facility Permit and Fact Sheet for Domtar, Point Edwards, WI - WI0003620.	Permit, Registration	WI DNR	01/01/2013	WI DNR. 2013. NPDES Permit and Fact Sheet for Domtar, Point Edwards, WI - WI0003620. (January 1).	Pulp, Paper, and Paperboard	104	No	No	08480
10.49	EPA-HQ-OW-2015-0665-0469	Wisconsin Department of Natural Resources (WI DNR). National Pollutant Discharge Elimination System Facility Permit and Fact Sheet for NPDES WI0003212 - Flambeau River Papers, Park Falls, WI - DCN 08481	NPDES Facility Permit and Fact Sheet for Flambeau River Papers, Park Falls, WI - WI0003212.	Permit, Registration	WI DNR	08/01/2015	WI DNR. 2015. NPDES Permit and Fact Sheet for Flambeau River Papers, Park Falls, WI - WI0003212. (August 1).	Pulp, Paper, and Paperboard	96	No	No	08481

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10.49	EPA-HQ-OW-2015-0665-0470	Telephone and Email Communication Between Jake Zimmerman, Wisconsin DNR, and Kimberly Bartell, ERG. Re: Pulp and Paper Mill Facility Permitting Practices in Wisconsin - DCN 08482	Telephone and email conversation between Jake Zimmerman, Wisconsin DNR, and Kimberly Bartell, Eastern Research Group, Inc about Pulp and Paper Mill Permitting Practices in Wisconsin.	Meeting Materials	Zimmerman, J.	03/28/2016	Zimmerman, J. 2016. Communication Between Jake Zimmerman, Wisconsin DNR, and Kim Bartell, ERG. Re: Permitting Practices in Wisconsin. (March 28).	Pulp, Paper, and Paperboard	4	No	No	08482
10.5	EPA-HQ-OW-2015-0665-1025	Final 2016 Effluent Guidelines Program Plan – DCN 08317	Final 2016 Plan for the Industrial Effluent Guidelines Program.	Publication; USEPA	U.S. EPA	04/24/2018	U.S. EPA. 2018. Final 2016 Effluent Guidelines Program Plan		51	No	No	08317
10.5	EPA-HQ-OW-2015-0665-1056	Effluent Guidelines Planning Review Report Supporting the Final 2016 Effluent Guidelines Program Plan - DCN 08318	The report containing the analyses completed during the ELG review supporting the Final 2016 Plan.	Publication; USEPA	U.S. EPA	04/24/2018	U.S. EPA. 2018. ELG Planning Review Report Supporting the Final 2016 Plan		261	No	No	08318

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10.5	EPA-HQ-OW-2015-0665-1115	Effluent Guidelines Planning Review Report Supporting the Final 2016 Effluent Guidelines Program Plan Appendices - DCN 08319	Appendices supporting the Effluent Guidelines Planning Review Report Supporting the Final 2016 Effluent Guidelines Program Plan.	Publication; USEPA	U.S. EPA	04/24/2018	U.S. EPA. 2018. Appendices supporting the ELG Planning RR Supporting the Final 2016 Plan.		46	No	No	08319
10.5	EPA-HQ-OW-2015-0665-0317	A Review of Battery Life-Cycle Analysis: State of Knowledge and Critical Needs - DCN 08320	A literature review and evaluation has been conducted on cradle-to-grave life-cycle inventory studies of lead-acid, nickel-cadmium, nickel-metal hydride, sodium-sulfur, and lithium-ion battery technologies.	Study	Argonne National Lab	10/01/2010	Argonne National Laboratory (ANL). 2010. A Review of Battery Life-Cycle Analysis: State of Knowledge and Critical Needs. E. S. Division. (Oct 1).	Battery Manufacturing	45	No	No	08320
10.5	EPA-HQ-OW-2015-0665-0318	BASF Catalysts. Nickel Metal-Hydride - DCN 08321	BASF offers licenses for its Ovonic Nickel Metal-Hydride (NiMH) technology. They hope to continue to develop state-of-the-art- technology	Fact/Data Sheet	BASF	08/10/2016	BASF. 2016. Catalysts. Nickel Metal- Hydride.	Battery Manufacturing	2	No	No	08321

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10.5	EPA-HQ-OW-2015-0665-0319	U.S. Lithium-Ion Battery Makers Await Transportation Transformation. Battery Boom - DCN 08322	Publication discussing the future of advanced batteries.	Publication; Copyrighted Materials	Bomgardner, M.	02/06/2012	Bomgardner, Melody. 2012. U.S. Lithium-Ion Battery Makers Await Transportation Transformation. Battery Boom. (February 6). 90(6): 18-20.	Battery Manufacturing	9	No	Yes	08322
10.5	EPA-HQ-OW-2015-0665-0320	Evaluation of U.S. Economic Census Data for the Battery Manufacturing Industry - DCN 08323	Excel sheet detailing an evaluation of the U.S. Economic Census Data for the battery manufacturing NAICS codes.	Analysis	ERG	10/01/2016	ERG. 2016. Evaluation of U.S. Economic Census Data for the Battery Manufacturing Industry. Chantilly, VA. (October).	Battery Manufacturing	1	No	No	08323
10.5	EPA-HQ-OW-2015-0665-0321	Review of Battery Manufacturers Identified in DMR, TRI, and ECHO Databases - DCN 08324	Review of Battery Manufacturers Identified in DMR, TRI, and ECHO Databases for the ELG Planning Review Report Supporting the Final 2016 ELG Plan.	Analysis	ERG	08/01/2016	ERG. 2016. Review of Battery Manufacturers Identified in DMR, TRI, and ECHO Databases for the RR Supporting the Final 2016 Plan. (August).	Battery Manufacturing	1	No	No	08324

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10.5	EPA-HQ-OW-2015-0665-0509	Summary of Information Gathered at the 2016 SEMICON West Conference and Intersolar North America, San Francisco, CA - DCN 08325	Memorandum from Kim Bartell, ERG, to Jezebele Alicea and Emily Trentacoste, EPA discussing the information gathered at the 2016 SEMICON West Conference and Intersolar North America, San Francisco CA.	Memorandum	ERG	08/03/2016	ERG. 2016. Memorandum from Kim Bartell, ERG, to Jezebele Alicea and Emily Trentacoste, EPA, Re: SEMICON West Conference and Intersolar. (August 3).	Battery Manufacturing	3	No	No	08325
10.5	EPA-HQ-OW-2015-0665-0322	Charging Forward: Fuel Efficiency Trends Will Increase Demand from Automakers - DCN 08326	IBISWorld Industry Report 33591: Charging Forward: Fuel Efficiency Trends Will Increase Demand from Automakers	Publication; Copyrighted Materials	IBISWorld	02/01/2016	IBISWorld. 2016. Charging Forward: Fuel Efficiency Trends Will Increase Demand from Automakers. IBISWorld Industry Report 33591. (February).	Battery Manufacturing	39	No	Yes	08326
10.5	EPA-HQ-OW-2015-0665-0323	NPDES Permit for C&D Technologies, Attica, IN (IN0049093) - DCN 08327	NPDES Permit for C&D Technologies, Attica, IN (IN0049093) issued by the Indiana Department of Environmental Management.	Permit, Registration	IDEM	01/17/2014	IDEM. 2014. Indiana Department of Environmental Management. NPDES Permit for C&D Technologies, Attica, IN (IN0049093). (January 17).	Battery Manufacturing	75	No	No	08327

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10.5	EPA-HQ-OW-2015-0665-0324	NPDES Permit and Fact Sheet for Exide Technologies, Manchester, IA (IA0063533) - DCN 08328	NPDES Permit and Fact Sheet for Exide Technologies, Manchester, IA (IA0063533) issued by the Iowa Department of Natural Resources	Permit, Registration	IA DNR	10/01/2014	IDNR. 2014. Iowa Department of Natural Resources. NPDES Permit and Fact Sheet for Exide Technologies, Manchester, IA (IA0063533). (October 1).	Battery Manufacturing	20	No	No	08328
10.5	EPA-HQ-OW-2015-0665-0325	Battery Manufacturing at Tesla Motors -Gigafactory in Sparks, NV - DCN 08329	Facility Data Review and Calculations for Point Source Category – 420 – Iron and Steel Manufacturing for the ELG Planning Review Report Supporting the Final 2016 ELG Plan.	Meeting materials	Jackson, J.	06/09/2016	Jackson, J. 2016. Telephone Communication Between Jeff Jackson, Tesla, and Liz Gentile, ERG, Re: Battery Manufacturing at Tesla Motors. (June 9).	Battery Manufacturing	4	No	No	08329
10.5	EPA-HQ-OW-2015-0665-0326	Scientific Reports: Solvent-Free Manufacturing of Electrodes for Lithium-ion Batteries - DCN 08330	Journal article describing electrochemical tests show that the new electrodes outperform conventional slurry processed electrodes, which is due to different binder distribution.	Publication	Ludwig, B., et al.	03/17/2016	Ludwig, B., et al. 2016. Solvent-Free Manufacturing of Electrodes for Lithium-ion Batteries. Scientific Reports. (March 17). 6(23150).	Battery Manufacturing	10	No	No	08330

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10.5	EPA-HQ-OW-2015-0665-0327	Overview of the Design, Development, and Application of Nickel-Hydrogen Batteries - DCN 08331	This document provides an overview of the design, development, and application of nickel-hydrogen (Ni-H2) battery technology for aerospace applications. It complements and updates the information presented in NASA RP–1314,"NASA Handbook for Nickel-Hydrogen Batteries," published in 1993.	Publication	Thaller & Zimmerman	06/01/2003	Thaller, L. H., & Zimmerman, A. H. 2003. Overview of the Design, Development, and Application of Nickel-Hydrogen Batteries.	Battery Manufacturing	44	No	No	08331
10.5	EPA-HQ-OW-2015-0665-0328	U.S. Census FAQ: What is the difference between an establishment and firm? What about companies? - DCN 08332	U.S. Economic Census Beaureau Frequently Asked Questions: What is the difference between an establishment and firm? What about companies?"	Fact/Data Sheet	U.S. Economic Census.	07/14/2016	U.S. Economic Census. 2016. "FAQ: What is the difference between an establishment and firm? What about companies?" Accessed: July 14, 2016.	Battery Manufacturing	2	No	No	08332
10.5	EPA-HQ-OW-2015-0665-0329	Battery cell production begins at the gigafactory - DCN 08333	Tesla and Panasonic begin mass production of lithium-ion battery cells, which will be used in Tesla's energy storage products and Model 3.	Press Release	Tesla Motors	01/04/2017	Tesla Motors. 2017. Tesla Energy. Battery Cell Production Begins at the Gigafactory. Accessed: February 17, 2017.	Battery Manufacturing	2	No	No	08333

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11.3	EPA-HQ-OW-2015-0665-0511	Telephone and Email Communication Between Jory Becker, KY DEP, and Sara Bossenbroek, ERG. Re: Distillery and Soft Drink Manufacturing Facilities in Kentucky - DCN 08522	Telephone and email conversation between Jory Becker, Kentucky DEP, and Sara Bossenbroek, Eastern Research Group, Inc. about Distillery and Soft Drink Manufacturing Facilities in Kentucky.	Meeting Materials	Becker, J.	03/30/2017	Becker, J. 2017. Communication Between Jory Becker, KY DEP, and Sara Bossenbroek, ERG. Re: Distillery and Soft Drink Facilities. (March 30).	Miscellaneous Foods and Beverages	9	No	No	08522
11.3	EPA-HQ-OW-2015-0665-0512	Telephone and Email Communication Between Reuel Anderson, Nebraska Department of Environmental Quality, and Elizabeth Gentile, ERG. Re: Wis Pak 2015 DMR Data - DCN 08525	Telephone and email conversation between Reuel Anderson, Nebraska Department of Environmental Quality, and Elizabeth Gentile, Eastern Research Group, Inc., Re: Wis Pak 2015 DMR Data	Meeting Materials	Anderson, R.	03/27/2017	Anderson. 2017. Communication Between Reuel Anderson, NE DEQ, and Elizabeth Gentile, ERG, Re: Wis Pak 2015 DMR Data. (March 27).		3	No	No	08525
11.3	EPA-HQ-OW-2015-0665-0513	Telephone and Email Communication Between Don Carlson, Kansas Department of Health and Environment, and Sara Bossenbroek, ERG. Re: Distilleries in Kansas - DCN 08526	Telephone and email conversation between Don Carlson, Kansas Department of Health and Environment, and Sara Bossenbroek, Eastern Research Group, Inc., Re: Distilleries in Kansas	Meeting Materials	Carlson, D.	04/03/2017	Carlson, D. 2017. Communication Between Don Carlson, KS DHE, and Sara Bossenbroek, ERG. Re: Distilleries in Kansas. (April 3).	Miscellaneous Foods and Beverages	2	No	No	08526

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11.3	EPA-HQ-OW-2015-0665-0514	Miscellaneous Food and Beverage Review—Revised SIC and NAICS Codes - DCN 08527	Miscellaneous Food and Beverage Review—Revised SIC and NAICS Codes	Data	ERG	12/20/2016	ERG. 2016. Eastern Research Group, Inc. Miscellaneous Food and Beverage Review—Revised SIC and NAICS Codes. (December 21).	Miscellaneous Foods and Beverages	0	No	No	08527
11.3	EPA-HQ-OW-2015-0665-0515	Kansas Department of Health & Environment (KS DHE). National Pollutant Discharge Elimination System Facility Permit and Fact Sheet for NPDES KS0100269 - MGP Ingredients, Inc. Atchison, KS - DCN 08528	NPDES Facility Permit and Fact Sheet for MGP Ingredients, Inc. (Midwest Grain Products, Inc.) Atchison, KS - KS0100269	Permit, Registration	KS DHE	07/19/2011	KS DHE. 2011. NPDES Permit and Fact Sheet: MGP Ingredients, Inc., Atchison, KS, KS0100269. (July 19).	Miscellaneous Foods and Beverages	18	No	No	08528
11.3	EPA-HQ-OW-2015-0665-0516	Kentucky Department of Environmental Protection (KY DEP). National Pollutant Discharge Elimination System Facility Permit and Fact Sheet for NPDES KY0001252 - Jim Beam Brands Company. Frankfort, KY - DCN 08529	NPDES Facility Permit and Fact Sheet for Jim Beam Brands Company. Frankfort, KY - KY0001252	Permit, Registration	KY DEP	08/01/2013	KY DEP. 2013. NPDES Permit and Fact Sheet: Jim Beam Brands Company, Frankfort, KY, KY0001252. (August 1).	Miscellaneous Foods and Beverages	79	No	No	08529

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11.3	EPA-HQ-OW-2015-0665-0517	Kentucky Department of Environmental Protection (KY DEP). National Pollutant Discharge Elimination System Facility Permit and Fact Sheet for NPDES KYR000000 - Pepsi Cola Bottling Company. Corbin, KY - DCN 08530	NPDES Facility Permit and Fact Sheet for Pepsi Cola Bottling Company. Corbin, KY - KYR000000	Permit, Registration	KY DEP	06/01/2013	KY DEP. 2013. NPDES Permit, Fact Sheet, and Coverage Letter: Pepsi Cola Bottling Company, Corbin, KY, KYR000000. (June 1).	Miscellaneous Foods and Beverages	58	No	No	08530
11.3	EPA-HQ-OW-2015-0665-0518	Kentucky Department of Environmental Protection (KY DEP). National Pollutant Discharge Elimination System Facility Permit and Fact Sheet for NPDES KY0001643 - Wild Turkey Distillery. Lawrenceburg, KY - DCN 08531	NPDES Facility Permit and Fact Sheet for Wild Turkey Distillery. Lawrenceburg, KY - KY0001643	Permit, Registration	KY DEP	07/01/2015	KY DEP. 2015. NPDES Permit and Fact Sheet: Campari America, Lawrenceburg, KY, KY0001643. (July 1).	Miscellaneous Foods and Beverages	53	No	No	08531
11.3	EPA-HQ-OW-2015-0665-0519	Kentucky Department of Environmental Protection (KY DEP). National Pollutant Discharge Elimination System Facility Permit and Fact Sheet for NPDES KY0001031 - The Glenmore Distillery. Owensboro, KY - DCN 08532	NPDES Facility Permit and Fact Sheet for The Glenmore Distillery. Owensboro, KY - KY0001031	Permit, Registration	KY DEP	04/01/2016	KY DEP. 2016. NPDES Permit: The Glenmore Distillery, Owensboro, KY, KY0001031. (April 1).	Miscellaneous Foods and Beverages	46	No	No	08532

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11.3	EPA-HQ-OW-2015-0665-0520	Kentucky Department of Environmental Protection (KY DEP). National Pollutant Discharge Elimination System Facility Permit and Fact Sheet for NPDES KY0102261 - The Woodford Reserve Distillery. Versailles, KY - DCN 08533	NPDES Facility Permit and Fact Sheet for The Woodford Reserve Distillery. Versailles, KY - KY0102261	Permit, Registration	KY DEP	06/01/2013	KY DEP. 2016. NPDES Permit, Fact Sheet, and Coverage Letter: Woodford Reserve Distillery, Versailles, KY, KY0102261. (June 1).	Miscellaneous Foods and Beverages	75	No	No	08533
11.3	EPA-HQ-OW-2015-0665-0521	Telephone and Email Communication Between Murray Lantner, EPA Region 2, and Elizabeth Gentile, ERG. Re: Distillery Discharges in the Virgin Islands - DCN 08534	Telephone and email conversation between Murray Lantner, EPA Region 2, and Elizabeth Gentile, Eastern Research Group, Inc., Re: Distillery Discharges in the Virgin Islands.	Meeting Materials	Lantner, M.	03/31/2017	Lantner, M. 2017. Communication Between Murray Lantner, EPA Region 2, and Elizabeth Gentile, ERG. Re: Distillery Discharges in the Virgin Islands.	Miscellaneous Foods and Beverages	4	No	No	08534
11.3	EPA-HQ-OW-2015-0665-0522	Telephone Communication Between Darin LeCrone, Illinois EPA and Elizabeth Gentile, ERG. Re: NPDES Permits for Distilleries in Illinois. (March 31) - DCN 08535	Telephone conversation between Darin LeCrone, Illinois EPA and Elizabeth Gentile, Eastern Research Group, Inc., Re: NPDES Permits for Distilleries in Illinois.	Meeting Materials	LeCrone, D.	03/31/2017	LeCrone, D. 2017. Communication Between Darin LeCrone, IL EPA and Elizabeth Gentile, ERG. Re: NPDES Permits for Distilleries in IL. (March 31).	Miscellaneous Foods and Beverages	1	No	No	08535

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11.3	EPA-HQ-OW-2015-0665-0523	Nebraska Department of Water Quality (NE DEQ). National Pollutant Discharge Elimination System Facility Permit and Fact Sheet for NPDES NE0131059 - Wis Pak of Norfolk, Inc. Norfolk, NE - DCN 08536	NPDES Facility Permit and Fact Sheet for Wis Pak of Norfolk, Inc. Norfolk, NE - NE0131059	Permit, Registration	NE DEQ	09/02/2015	NE DEQ. 2015. NPDES Permit and Fact Sheet: Wis Pak of Norfolk, Inc., NE0131059. (September 2).	Miscellaneous Foods and Beverages	36	No	No	08536
11.3	EPA-HQ-OW-2015-0665-0524	Telephone Communication Between Eric Nygaard, Ohio EPA, and Elizabeth Gentile, ERG. Re: G&J Pepsi Cola Bottling Co – 2015 DMR Data - DCN 08537	Telephone conversation between Eric Nygaard, Ohio EPA, and Elizabeth Gentile, Eastern Research Group, Inc., Re: G&J Pepsi Cola Bottling Co – 2015 DMR Data	Meeting Materials	Nygaard, E.	03/27/2017	Nygaard, E. 2017. Communication Between Eric Nygaard, OH EPA, and Elizabeth Gentile, ERG. Re: G&J Pepsi Cola Bottling Co. (March 27).	Miscellaneous Foods and Beverages	1	No	No	08537
11.3	EPA-HQ-OW-2015-0665-0525	U.S. Economic Census Data for NAICS 312111 and NAICS 312140 - DCN 08538	U.S. Census. 2012. U.S. Economic Census Data for NAICS 312111 and NAICS 312140. Available online at: https://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t#.	Data	U.S. Census	07/04/1905	2012. U.S. Census Data for NAICS 312111 and NAICS 312140.	Miscellaneous Foods and Beverages	4	No	No	08538

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11.3	EPA-HQ-OW-2015-0665-0526	U.S. Virgin Islands Department of Planning and Natural Resources (V.I. DPNR). Territorial Pollutant Discharge Elimination System Facility Permit and Fact Sheet for TPDES VI0020052 - Cruzan VIRIL Ltd. Frederiksted, VI - DCN 08539	TPDES Facility Permit and Fact Sheet for Cruzan VIRIL Ltd. Frederiksted, VI - VI0020052	Permit, Registration	V.I. DPNR	07/25/2016	U.S. V.I. DPNR. 2016. TPDES Permit and Fact Sheet: Cruzan VIRIL Ltd. (Cruzan Rum Distillery), Frederiksted, St. Croix, VI0020052.	Miscellaneous Foods and Beverages	97	No	No	08539
11.3	EPA-HQ-OW-2015-0665-0527	Telephone and Email Communication Between Gil Vazquez, California State Water Resources Control Board, and Sara Bossenbroek, ERG. Re: Distillery and Soft Drink Manufacturing Facilities in California - DCN 08540	Telephone and email conversation between Gil Vazquez, California State Water Resources Control Board, and Sara Bossenbroek, Eastern Research Group, Inc., Re: Distillery and Soft Drink Manufacturing Facilities in California.	Meeting Materials	Vazquez, G.	03/28/2017	2017. Communication Between Gil Vazquez, CA WRCB, and Sara Bossenbroek, ERG. Re: Distillery and Soft Drink Facilities in CA.	Miscellaneous Foods and Beverages	3	No	No	08540
11.6	EPA-HQ-OW-2015-0665-0356	Chemical mechanical planarization of electronic materials - DCN 08360	In the modern semiconductor manufacturing processes, chemical mechanical planarization (CMP) has attained important processing step because of its ability to provide global planarization. CMP is the planarization technique which is used for the removal of excess material, as left over from the previous processing steps. In addition, CMP offers a uniform surface that is essential for subsequent processing steps, especially for the high resolution photolithography processes.	Publication; Copyrighted Materials	Atiquzzaman, F.	10/17/2012	Atiquzzaman, F. (2012). Chemical mechanical planarization of electronic materials. University of Florida Scholar Commons.	Nanomaterials	87	No	Yes	08360

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11.6	EPA-HQ-OW-2015-0665-0357	Detection, characterization, and abundance of engineered nanoparticles in complex waters by hyperspectral imagery with enhanced darkfield microscopy - DCN 08361	Novel methodology based on hyperspectral imagery with enhanced Darkfield microscopy for detection, characterization, and analysis of engineered nanoparticles in both ultrapure water and in complex waters, such as simulated-wetland ecosystem water and wastewater.	Publication; Copyrighted Materials	Badireddy, A.	08/18/2012	Badireddy, A., et al. (2012). Detection, characterization, and abundance of engineered nanoparticles. ES&T. 46(18): 10081-10088.	Nanomaterials	8	No	Yes	08361
11.6	EPA-HQ-OW-2015-0665-0358	Applications of nanotechnology in wastewater treatment – A review - DCN 08362	In this article, the application of various nanomaterials such as metal nanoparticles, metal oxides, carbon compounds, zeolite, filtration membranes, etc., in the field of wastewater treatment is discussed.	Publication; Copyrighted Materials	Bora, T., & Dutta, J.	02/01/2014	Bora, T., & Dutta, J. (2014). Applications of nanotechnology in wastewater treatment. Journal of Nanoscience and Nanotechnologie s. 14(1): 613-626.	Nanomaterials	15	No	Yes	08362
11.6	EPA-HQ-OW-2015-0665-0359	Quantifying Exposure to Engineered Nanomaterials (QEEN) from Manufactured Products: Addressing Environmental, Health, and Safety Implications - DCN 08363	NNI workshop proceedings to inform long-range planning efforts for the NNI and its EHS Research Strategy. Sponsored by the Consumer Product Safety Commission in collaboration with the NNI.	Meeting Materials	CPSC	07/07/2015	CPSC. (2016). U.S. Consumer Product Safety Commission. Addressing Environmental, Health, and Safety Implications. Arlington, VA. (July 7-8).	Nanomaterials	110	No	No	08363

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11.6	EPA-HQ-OW-2015-0665-0360	Insights into the effect of mixed engineered nanoparticles on activated sludge performance - DCN 08364	In this study, the effects, fate and transport of engineered nanoparticles (ENPs) in wastewater treatment plants (WWTP) were investigated using three parallel pilot WWTPs operated under identical conditions. Competitive growth advantage of thenano-tolerant species influenced the removal processes and unlike other xenobiotic compounds, ENPs can hasten the natural selection of microbial species in activated sludge.	Publication; Copyrighted Materials	Eduok, S., et al.	07/13/2015	Eduok, S., et al. (2015). Insights into the effect of mixed ENMs on activated sludge performance. FEMS Microbiology Ecology. 91(7). (July).	Nanomaterials	9	No	Yes	08364
11.6	EPA-HQ-OW-2015-0665-0361	Framework and tools for risk assessment of manufactured nanomaterials - DCN 08365	Today we face challenges to assess enivornmental, health, and safety (EHS) risks, which emerge from uncertainties around the interactions of manufactured nanomaterials (MNs) with humans and the environment. In order to reduce these uncertainties, it is necessary to generate sound scientific data on hazard and exposure by means of relevant frameworks and tools. The aim of this paper was to review and critically analyze these approaches against a set of relevant criteria.	Publication; Copyrighted Materials	Hristozov, D., et al.	07/20/2016	Hristozov, D., et al. (2016). Framework and tools for risk assessment of manufactured nanomaterials. Environmental International. (Aug).	Nanomaterials	19	No	Yes	08365
11.6	EPA-HQ-OW-2015-0665-0362	Nanomaterials in biosolids inhabit nodulation, shift microbial community composition, and result in increased metal uptake relative to bulk/dissolved metals - DCN 08366	This report examines the effects of amending soil with biosolids produced from a pilot-scale wastewater treatment plant containing a mixture of metal-based engineered nanomaterials (ENMs) on the growth of Medicago truncatula, its symbiosis with Sinorhizobium meliloti, and on soil microbial community structure.	Publication; Copyrighted Materials	Judy, J. D., et al.	06/10/2015	Judy, J. D., et al. (2015). Nanomaterials result in increased metal uptake relative to bulk/dissolved metals. Environmental Science & Technology.	Nanomaterials	8	No	Yes	08366

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11.6	EPA-HQ-OW-2015-0665-0363	Fate and transformation of silver nanoparticles in urban wastewater systems - DCN 08367	Discharge of silver nanoparticles (Ag-NP) from textiles and cosmetics, todays major application areas for metallic Ag-NP, into wastewater is inevitable. Transformation and removal processes in sewers and wastewater treatment plants (WWTP) will determine the impact of Ag-NP on aquatic and terrestrial environments, via the effluents of the WWTP and via the use of digested sludge as fertilizer. The authors conducted experiments addressing the behavior of Ag-NP in sewers and in WWTP.	Publication; Copyrighted Materials	Kaegi, R., et al.	03/26/2013	Kaegi, R., et al. (2013). Fate and transformation of silver nanoparticles in urban wastewater systems. Water Research. 47(12): 3866-3877. (Aug).	Nanomaterials	12	No	Yes	08367
11.6	EPA-HQ-OW-2015-0665-0364	Predicted releases of engineered nanomaterials: From global to regional to local - DCN 08368	A key question for industry, regulators, toxicologists, and risk assessors working with nanomaterials is what relevant environmental engineered nanomaterial (ENM) concentrations should be considered. Answering this question requires ENM material flow estimates at the local level. Using a life-cycle approach, global ENM production and application data were used to estimate releases at global, regional, national, and local levels.	Publication; Copyrighted Materials	Keller, A.& Lazareva, A.	10/14/2013	Keller, A., & Lazareva, A. (2014). Predicted releases of engineered nanomaterials: From global to regional to local. ES&T Letters. 1(1): 65-70.	Nanomaterials	6	No	Yes	08368
11.6	EPA-HQ-OW-2015-0665-0365	Application of recycled zero-valent iron nanoparticle to the treatment of wastewater containing nitrobenzene - DCN 08369	Zero-valent iron (ZVI) was synthesized using iron oxide, a byproduct of pickling line at a steel work. When combined with a subsequent biological process, the synthesized ZVI will be able to decompose nitrobenzene (NB) in wastewater effectively.	Publication; Copyrighted Materials	Lee, H., et al.	11/16/2015	Lee, et al. (2015). Application of recycled zero-valent iron nanoparticle to the treatment of ww containing nitrobenzene. Journal of Nanomaterials.	Nanomaterials	9	No	Yes	08369

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11.6	EPA-HQ-OW-2015-0665-0366	An overview of nanomaterials for water and wastewater treatment - DCN 08370	In this paper, the most extensively studied nanomaterials, zero-valent metal nanoparticles (Ag, Fe, and Zn), metal oxide nanoparticles (TiO2, ZnO, and iron oxides), carbon nanotubes (CNTs), and nanocomposites are discussed and highlighted in detail. Also, future aspects of nanomaterials in water and wastewater treatment are discussed.	Publication; Copyrighted Materials	Lu, H., et al.	06/23/2016	Lu, H., et al. (2016). An overview of nanomaterials for water and wastewater treatment. Advances in Materials Science and Engineering. (June).	Nanomaterials	11	No	Yes	08370
11.6	EPA-HQ-OW-2015-0665-0367	National Nanotechnology Initiative Environmental, Health, and Safety Research Strategy - DCN 08371	This document is the NNI's Environmental, Health, and Safety (EHS) Research Strategy. The NNI EHS Research Strategy aims to ensure the responsible development of nanotechnology by providing guidance to the Federal agencies that produce the scientific information for risk management, regulatory decision making, product use, research planning, and public outreach. This document describes the NNI's EHS vision and mission, the state of the science, and the research needed to achieve the vision.	Publication; Other Governmental	NNI	10/01/2011	NNI. (2011). NNI Environmental Health and Safety Plan. National Science and Technology, Council Committee of Technology. (Oct).	Nanomaterials	136	No	No	08371
11.6	EPA-HQ-OW-2015-0665-0368	National Nanotechnology Initiative Strategic Plan - DCN 08372	This document is the strategic plan for the NNI. It describes the NNI vision and goals and the strategies by which these goals are to be achieved. The plan includes a description of the NNI investment strategy and the program component areas called for by the 21st Century Research and Development Act of 2003, and it also identifies specific objectives toward collectively achieving the NNI vision.	Publication; Other Governmental	NNI	10/01/2016	NNI. (2016). NNI Strategic Plan. National Science and Technology, Council Committee of Technology. (Oct).	Nanomaterials	68	No	No	08372

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11.6	EPA-HQ-OW-2015-0665-0369	Current limitations and challenges in nanowaste detection, characterization and monitoring - DCN 08373	This paper summarizes challenges in nanowaste characterization and appropriate analytical techniques which can be applied to nanowaste analysis. Recent case studies focusing on the characterization of ENMs in waste streams are discussed.	Publication; Copyrighted Materials	Part, F., et al.	06/24/2015	Part, F. (2015). Current limitations and challenges in nanowaste detection, characterization and monitoring. Waste Management. 43: 407-420. (Sept).	Nanomaterials	14	No	Yes	08373
11.6	EPA-HQ-OW-2015-0665-0370	Consumer Products Inventory - DCN 08374	Consumer Products Inventory for products utilizing nanomaterials in manufacturing processes.	Study	PEN	01/01/2016	Project on Emerging Nanotechnologies. (2016). Consumer Products Inventory. Available online: http://www.nanotechproject.org/cpi. Accessed: Dec 2016.	Nanomaterials	12	No	No	08374
11.6	EPA-HQ-OW-2015-0665-0371	SEM analysis of particle size during conventional treatment of CMP process wastewater - DCN 08375	This study investigates the fate of ENMs used in chemical mechanical planarization (CMP), a polishing process repeatedly utilized in semiconductor manufacturing. Nanoparticle sizing data compared between sampling points, including the final sampling point before discharge from the facility, suggested that nanoparticles could be released to the municipal waste stream from industrial sources.	Publication; Copyrighted Materials	Roth, G. A., et al.	11/28/2014	Roth, G. A. (2015). SEM analysis of particle size during conventional treatment of CMP process ww. Science of the Total Environment. 508: 1-6. (Mar).	Nanomaterials	6	No	Yes	08375

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11.6	EPA-HQ-OW-2015-0665-0372	The current world of nanomaterial characterization: Discussion of analytical instruments for nanomaterial characterization - DCN 08376	This article addresses the nine most common nanomaterial characteristics and nearly 35 different analytical techniques commercially available to measure these nine characteristics. This article discusses the complexity of the nanotechnology market and the challenges the instrument manufacturers face.	Publication; Copyrighted Materials	Salamon, A.	01/24/2013	Salamon. (2013). The current world of nanomaterial characterization: Discussion of analytical instrument. Environmental Engineering Science. 30(3).	Nanomaterials	8	No	Yes	08376
11.6	EPA-HQ-OW-2015-0665-0373	Nanomaterials in the aquatic environment: A European Union–United States perspective on the status of ecotoxicity testing, research priorities, and challenges ahead - DCN 08377	Based on work within the Ecotoxicology Community of Research (2012–2015), the article provides an overview of the state of the art of nanomaterials (NMs) in the aquatic environment by addressing different research questions, with a focus on ecotoxicological test systems and the challenges faced when assessing NM hazards (e.g., uptake routes, bioaccumulation, toxicity, test protocols, and model organisms).	Publication; Copyrighted Materials	Selck, H., et al.	05/01/2016	Selck, et al. (2016). Nanomaterials in the aquatic environment: A EU–US perspective. Environmental Toxicology and Chemistry. 35(5): 1055-1067. (May).	Nanomaterials	13	No	Yes	08377
11.6	EPA-HQ-OW-2015-0665-0374	Comprehensive probabilistic modelling of environmental emissions of engineered nanomaterials - DCN 08378	Authors calculate the concentrations of five ENMs in environmental and technical compartments using probabilistic material-flow modelling. We apply the newest data on ENM production volumes, their allocation to and subsequent release from different product categories, and their flows into and within those compartments. Further, we compare newly predicted ENM concentrations to estimates from 2009 and to corresponding measured concentrations of their conventional materials, e.g. TiO2, Zn and Ag.	Publication; Copyrighted Materials	Sun, T. Y., et al.	10/04/2013	Sun, T. Y., et al. (2014). Comprehensive probabilistic modelling of environmental emissions of ENMs. Environmental Pollution. 185: 69-76. (February).	Nanomaterials	8	No	Yes	08378

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11.6	EPA-HQ-OW-2015-0665-0375	Schedule for the 2016 TechConnect World Innovation Conference and Expo in Washington, D.C. - DCN 08379	Technical sessions schedule for TechConnect 2016	Meeting Materials	TechConnect	05/22/2016	TechConnect. (2016). Paper presented at or proceedings from the TechConnect World Innovation Conference and Expo. Washington, D.C. (May 22-26).	Nanomaterials	8	No	No	08379
11.6	EPA-HQ-OW-2015-0665-0376	Analysis of engineered nanomaterials in complex matrices (environment and biota): General considerations and conceptual case studies - DCN 08380	Discusses pressing research needs related to nanomaterials: the development of techniques for extraction, cleanup, separation, and sample storage that introduce minimal artifacts to increase the speed, sensitivity, and specificity of analytical techniques, as well as the development of techniques that can differentiate between abundant, naturally occurring particles, and manufactured nanoparticles.	Publication; Copyrighted Materials	von der Kammer, F, et al	06/29/2011	von der Kammer, F., et al. (2012). Analysis of ENMs in complex matrices. Environmental Toxicology and Chemistry. 31: 32-49. (Jan).	Nanomaterials	18	No	Yes	08380
11.6	EPA-HQ-OW-2015-0665-0377	Long-term effects of titanium dioxide nanoparticles on nitrogen and phosphorus removal from wastewater and bacterial community shift in activated sludge - DCN 08381	This study evaluated the influences of TiO2 nanoparticles on biological nutrient removal in the anaerobic-low dissolved oxygen (0.15 0.50 mg/L) sequencing batch reactor.	Publication; Copyrighted Materials	Zheng, X., et al	07/22/2011	Zheng, X. (2011). Long-term effects of titanium dioxide nanoparticles on nitrogen and phosphorus removal. ES&T. 45(17): 7284-7290.	Nanomaterials	7	No	Yes	08381

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11.6	EPA-HQ-OW-2015-0665-0378	Comparison of Ceria Nanoparticle Concentrations in Effluent from Chemical Mechanical Polishing of Silicon Dioxide - DCN 08382	This paper measures and compares the effluent from the chemical mechanical polishing (CMP) of silicon dioxide using ceria slurry and ceria fixed abrasive.	Publication; Copyrighted Materials	Zazerra, L., et al	10/15/2014	Zazzera, L., et al. 2014. Comparison of Ceria Nanoparticle Concs in Effluent from CMP of Silicon Dioxide. ES&T, 48(22), 13427-13433.	Nanomaterials	7	No	Yes	08382
12.2	EPA-HQ-OW-2015-0665-0379	Export of Industrial Wastewater Treatment Technology (IWTT) Database Tables - DCN 08383	Tables exported for the section in the ELG Planning Review Report Supporting the Final 2016 ELG Plan on the Industrial Wastewater Treatment Technology Database.	Data	ERG	09/01/2016	ERG. (2016). Eastern Research Group,, Inc. Export of Industrial Wastewater Treatment Technology (IWTT) database tables.		0	No	No	08383
6.0		User Guide to the Docket for the Final 2016 Effluent Guidelines Program Plan - DCN 08544	Docket user guide explaining how to navigate the docket for supporting materials referenced in the Final 2016 Plan.	Publication USEPA	U.S. EPA	04/24/2018	U.S. EPA. 2018. User Guide to the Docket for the Final 2016 Effluent Guidelines Program Plan. (April).		17	No	No	08544

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7.13	EPA-HQ-OW-2015-0665-1057	Response to Comments for the Preliminary 2016 Effluent Guidelines Program Plan - DCN 08521	This document contains EPA's responses to the public comments received on the Preliminary 2016 Plan. The Preliminary 2016 Plan, which EPA is required to develop by Section 304(m) of the CWA, describes the current status of EPA's planning for the ELG program, presents the results of EPA's review of the ELGs it has already promulgated for industrial categories, and identifies industrial categories that EPA expects to investigate further for the possible development or revision of ELGs.	Publication USEPA	U.S. EPA	04/01/2018	U.S. EPA. 2016. Preliminary Comment Reponse Document (April).		109	No	No	08521
9.1	EPA-HQ-OW-2015-0665-0401	Toxic Chemical Release Inventory Reporting Forms and Instructions - DCN 08405	TRI reporting instructions for reporting year 2014.	Publication; USEPA	U.S. EPA	12/01/2015	U.S. EPA. (2014). Toxic Chemical Release Inventory Reporting Forms and Instructions. Washington, D.C. (December). EPA 260-R-15-001.		215	No	No	08405
9.1	EPA-HQ-OW-2015-0665-0402	DMR Parameter and TRI Chemical Toxic Weighting Factors - DCN 08406	Table containing September 2016 DMR and TRI TWFs.	Data	U.S. EPA		U.S. EPA. (2016). DMR parameter and TRI chemical Toxic Weighting Factors. Washington, D.C.		0	No	No	08406

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9.1	EPA-HQ-OW-2015-0665-1092	2014 Toxics Release Inventory (TRI) Water Release Database - TRILTOutput2014_v1 - DCN 08409	2014 TRI water release data compiled in an access database, for the ELG Planning Review Report Supporting the Final 2016 ELG Plan.	Data	ERG	04/24/2018	DMR Loading Tool Output - 2014 TRI Water Release Data		0	No	No	08409
9.1	EPA-HQ-OW-2015-0665-0403	Toxics Release Inventory Data Quality - DCN 08411	Steps taken to promote data quality for TRI include analyzing data for potential errors, contacting TRI facilities concerning potentially inaccurate submissions, providing guidance on reporting requirements and, as necessary, taking enforcement actions against facilities that fail to comply with TRI requirements.	Fact/Data Sheet	U.S. EPA		U.S. EPA. (2016). Toxics Release Inventory data quality. Available at: https://www.epa.gov/toxics-release-inventory-tri-program/tri-data-quality.		3	No	No	08411
9.1	EPA-HQ-OW-2015-0665-0409	2014 TRI Chemical List - DCN 08418	Table containing 2014 Toxic Release Inventory chemical list.	Fact/Data Sheet	U.S. EPA	06/01/2015	U.S. EPA. 2015. 2014 TRI Chemical List. Toxics Release Inventory Program. Washington, D.C. (June).		0	No	No	08418

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9.1	EPA-HQ-OW-2015-0665-0410	Is My Facility's Six-Digit NAICS Code a TRI-Covered Industry? - DCN 08419	Instructions to determine if a facility's six-digit primary NAICS code is covered by the TRI program.	Fact/Data Sheet	U.S. EPA	02/03/2015	U.S. EPA. 2015. Is My Facility's Six-Digit NAICS Code a TRI-Covered Industry? Toxics Release Inventory Program. Washington, D.C. (February 3).		8	No	No	08419
9.1	EPA-HQ-OW-2015-0665-1095	2015 Toxics Release Inventory (TRI) Water Release Database for F&B -TRILTOutput2015_F&B_v1 - DCN 08524	2015 TRI water release data compiled in an access database, supporting the miscellaneous food and beverage review.	Data	ERG	12/31/2015	DMR Loading Tool Output - 2015 TRI Water Release Data	Miscellaneous Foods and Beverages	0	No	No	08524
9.2	EPA-HQ-OW-2015-0665-1090	2014 Discharge Monitoring Report (DMR) Concentration Output Database - DMRLTConcOutput2014_v1 - DCN 08407	2014 DMR concentration data compiled in an access database, for the ELG Planning Review Report Supporting the Final 2016 ELG Plan.	Data	ERG	04/24/2018	DMR Loading Tool Output - 2014 DMR Concentration Data		0	No	No	08407

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9.2	EPA-HQ-OW-2015-0665-1091	2014 Discharge Monitoring Report (DMR) Database - DMRLTOutput2014_v1 - DCN 08408	2014 DMR loadings data compiled in an access database, for the ELG Planning Review Report Supporting the Final 2016 ELG Plan.	Data	ERG	04/24/2018	DMR Loading Tool Output - 2014 DMR Loadings Data		0	No	No	08408
9.2	EPA-HQ-OW-2015-0665-0510	Final NPDES Electronic Reporting Rule - DCN 08520	This final rule is designed to save authorized state, tribe, or territorial NPDES programs considerable resources, make reporting easier for NPDES-regulated entities, streamline permit renewals, ensure full exchange of basic NPDES permit data between states and EPA, improve environmental decision-making, and better protect human health and the environment.	Fact/Data Sheet	U.S. EPA	09/01/2015	U.S. EPA. 2015. Final NPDES Electronic Reporting Rule. (September).		3	No	No	08520
9.2	EPA-HQ-OW-2015-0665-1094	2015 Discharge Monitoring Report (DMR) Database for F&B - DMRLTOutput2015_F&B_v1 - DCN 08523	2015 DMR loadings data compiled in an access database, supporting the miscellaneous food and beverage review.	Data	ERG	12/31/2015	DMR Loading Tool Output - 2015 DMR Loadings Data	Miscellaneous Foods and Beverages	0	No	No	08523

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9.3	EPA-HQ-OW-2015-0665-0399	Memorandum from ERG to Bill Swietlik, US EPA, Re: Comparison of Canada's National Pollutant Release Inventory and the Toxics Release Inventory Pollutant Data by Category for the Effluent Guidelines Planning Review Report Supporting the Final 2016 Effluent Guidelins Program Plan - DCN 08403	Memorandum describing the NPRI and TRI data comparison for the ELG Planning Review Report Supporting the Final 2016 ELG Plan.	Memorandum	ERG		ERG. (2015). Comparison of Canada's NPRI and the TRI Pollutant Data by Category for the RR Supporting the Final 2016 Plan. Chantilly, VA. (Dec).		14	No	No	08403
9.3	EPA-HQ-OW-2015-0665-1093	Canada's National Pollutant Release Inventory Database 2013 – NPRICompare2013 - DCN 08410	2013 NPRI water release data compiled in an access database, for the ELG Planning Review Report Supporting the Final 2016 ELG Plan.	Data	ERG	04/24/2018	NPRI Data Output - 2013 Water Release Data		0	No	No	08410
9.3	EPA-HQ-OW-2015-0665-0404	Frequently Asked Questions and the National Pollutant Release Inventory (NPRI) - DCN 08412	Fact sheet detailing frequently asked questions about Canada's NPRI database.	Fact/Data Sheet	Environment Canada	12/11/2013	Environment Canada. 2013. Frequently Asked Questions and the National Pollutant Release Inventory (NPRI). Gatineau, QC (December 11).		5	No	No	08412

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9.3	EPA-HQ-OW-2015-0665-0405	National Pollutant Release Inventory (NPRI) Sector Coverage Study for the 2008 Reporting Year - DCN 08413	Study conducted on NPRI data to analyze coverage and compliance.	Publication Copyrighted Material	Environment Canada	01/01/2013	Environment Canada. 2013. National Pollutant Release Inventory (NPRI) Sector Coverage Study for the 2008 Reporting Year. Gatineau, QC.		84	No	Yes	08413
9.3	EPA-HQ-OW-2015-0665-0411	2014-2015 NPRI Substance List - DCN 08414	Substance list for the 2014-2015 NPRI dataset.	Fact/Data Sheet	Environment Canada	11/28/2014	Environment Canada. 2014. 2014-2015 NPRI Substance List. Gatineau, QC (November 28).		0	No	No	08414
9.3	EPA-HQ-OW-2015-0665-0406	Raw NPRI Data: Inventaire national des rejets de polluants 2013 / National Pollutant Release Inventory 2013 - DCN 08415	Raw NPRI data set for 2013.	Data	Environment Canada	09/16/2014	Environment Canada. 2014. National Pollutant Release Inventory 2013. Gatineau, QC (September 16). Accessed: February 11, 2015.		0	No	No	08415

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9.3	EPA-HQ-OW-2015-0665-0407	Guide for Reporting to the National Pollutant Release Inventory 2014 and 2015 - DCN 08416	Reporting guide for NPRI designed to assist facility owners and operators in understanding the NPRI reporting requirements, and in determining if they are required to report to NPRI.	Publication; Copyrighted Materials	Environment Canada	01/01/2015	Environment Canada. 2015. Guide for Reporting to the National Pollutant Release Inventory 2014 and 2015. Gatineau, QC.		63	No	Yes	08416
9.3	EPA-HQ-OW-2015-0665-0408	Guide for Using and Interpreting the National Pollutant Release Inventory (NPRI) Data - DCN 08417	Guidance to analyze NPRI data.	Guidance	Environment Canada	03/25/2015	Environment Canada. 2015. Guide for Using and Interpreting the National Pollutant Release Inventory (NPRI) Data. Gatineau, QC (March 25).		5	No	No	08417
9.5	EPA-HQ-OW-2015-0665-0400	Memorandum from Jill Lucy, Eastern Research Group, Inc. to Bill Swietlik, U.S. EPA. Re: Review of Toxic Weighting Factors in Support of the Final Steam Electric Effluent Limitations Guidelines and Standards - DCN 08404	Memorandum describing the review and revision of TWFs in support of the Steam ELGs.	Memorandum	ERG	09/21/2015	ERG. (2015). Memorandum from Jill Lucy, ERG to Bill Swietlik, U.S. EPA. RE: Review of TWFs for the Steam ELGs. Chantilly, VA. (Sept 21).		19	No	No	08404

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1.1	EPA-HQ-OW-2015-0665-0530	Core Technologies - DCN CWT00003	Summary of core technologies created by Heartland Technology Partners, LLC.	Fact/Data Sheet	Heartland Technology Partners, LLC	01/01/2014	Heartland Technology Partners, LLC. 2014. Core Technologies. Available online at: http://www.heartlandtech.com/about/core-technologies.	Centralized Waste Treaters	2	No	No	CWT00003
1.1	EPA-HQ-OW-2015-0665-0536	Wastewater Technology Fact Sheet: Chemical Precipitation - DCN CWT00010	A fact sheet that describes advantages, disadvantages, additive chemicals, costs, and targeted pollutants.	Publication; USEPA	U.S. EPA	09/01/2000	U.S. EPA. 2000. Wastewater Technology Fact Sheet: Chemical Precipitation. EPA-832-F-00-018. (September).	Centralized Waste Treaters	8	No	No	CWT00010
1.1	EPA-HQ-OW-2015-0665-0537	Water Treatment Technology Fact Sheet: Crystallization - DCN CWT00011	A data/fact sheet that describes crystallization process description, technical capabilities, technical limitations, and costs.	Fact/Data Sheet	ALL Consulting	01/01/2011	ALL Consulting. 2011. Water Treatment Technology Fact Sheet: Crystallization.	Centralized Waste Treaters	2	No	No	CWT00011

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1.1	EPA-HQ-OW-2015-0665-0538	Water Treatment Technology Fact Sheet: Reverse Osmosis - DCN CWT00012	A data/fact sheet that describes reverse osmosis process description, technical capabilities, technical limitations, and costs.	Fact/Data Sheet	ALL Consulting	01/01/2011	ALL Consulting. 2011. Water Treatment Technology Fact Sheet: Reverse Osmosis.	Centralized Waste Treaters	3	No	No	CWT00012
1.1	EPA-HQ-OW-2015-0665-0539	EVRAS™ Evaporative Reduction and Solidification - DCN CWT00013	A fact sheet that describes the technical capabilities of the EVRAS, a evaporation/crystallization technology produce by Intervras.	Fact/Data Sheet	Intervras Technologies, LLC	01/01/2011	Intervras Technologies, LLC. 2011. EVRAS™ Evaporative Reduction and Solidification.	Centralized Waste Treaters	4	No	No	CWT00013
1.1	EPA-HQ-OW-2015-0665-0542	Technical Development Document for Effluent Limitations Guidelines and Standards for Oil and Gas Extraction - DCN CWT00019	The technical development for the unconventional oil and gas rule making.	Publication; USEPA	U.S. EPA	06/01/2016	U.S. EPA. 2016. Technical Development Document for Effluent Limitations Guidelines and Standards for Oil and Gas Extraction. EPA-820-R-16-003.	Centralized Waste Treaters	197	No	No	CWT00019

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1.1	EPA-HQ-OW-2015-0665-0545	Physicochemical Processes for Water Quality Control - DCN CWT00025	A textbook that discusses various wastewater treatment technologies. Discussions include basic principles and process descriptions. Sometimes descriptions are math intensive.	Publication; Copyrighted Material	Walter Weber	01/01/1972	Walter Weber. 1972. Physicochemical Processes for Water Quality Control. University of Michigan. Wiley-Interscience.	Centralized Waste Treaters	8	No	Yes	CWT00025
1.1	EPA-HQ-OW-2015-0665-0546	Wastewater Engineering: Treatment and Reuse - DCN CWT00026	A textbook that describes various wastewater treatment technologies from an engineering perspective and in reuse applications.	Publication; Copyrighted Material	Metcalf and Eddy	01/01/2003	Metcalf and Eddy. 2003. Wastewater Engineering: Treatment and Reuse. McGraw Hill. 4th Edition.	Centralized Waste Treaters	17	No	Yes	CWT00026
1.1	EPA-HQ-OW-2015-0665-0547	Water Treatment: Principles and Design - DCN CWT00027	A textbook that provides technical information on various wastewater treatment technologies: ion exchange, reverse osmosis, and other less advanced treatment technologies.	Publication; Copyrighted Material	Crittenden, John	01/01/2005	Crittenden, John. 2005. Water Treatment: Principles and Design. John Wiley & Sons, Inc. 2nd Edition.	Centralized Waste Treaters	12	No	Yes	CWT00027

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1.1	EPA-HQ-OW-2015-0665-0548	The Electrodialysis Alternative for Produced Water Management - DCN CWT00028	Article on electrodialysis as an economical separation process in the treatment of brackish water and as a treatment for the processing of produced waters with weak to moderate levels of TDS. Provides performance results for an integrated electrodialysis.	Report	Hayes, Tom	09/01/2004	Hayes, Tom. 2004. The Electrodialysis Alternative for Produced Water Management. Gas Technology Institute. (September)	Centralized Waste Treaters	6	No	No	CWT00028
1.1	EPA-HQ-OW-2015-0665-0550	Produced Water Pretreatment for Water Recovery and Salt Production - DCN CWT00032	A detailed report that investigates wastewater treatment technologies for shale gas wastewater.	Report	Silva, James	01/26/2012	Silva, James. 2012. Produced Water Pretreatment for Water Recovery and Salt Production Report 08122-36. RPSEA. (January 26).	Centralized Waste Treaters	67	No	No	CWT00032
1.1	EPA-HQ-OW-2015-0665-0555	Breakthrough Mobile Water Treatment Converts 75% of Fracturing Flowback Fluid to Fresh Water and Lowers CO2 Emissions - DCN CWT00038	This journal article provides information on an advanced oxidation treatment technology that is deployed in the Woodford shale play.	Publication; Copyrighted Material	Horn, Aaron	03/23/2009	Horn, Aaron. 2009. Breakthrough Mobile Water Treatment Converts 75% of Fracturing Flowback Fluid to Fresh Water and Lowers CO2 Emissions. SPE.	Centralized Waste Treaters	9	No	Yes	CWT00038

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1.1	EPA-HQ-OW-2015-0665-0556	Treatment of Flow Back and Produced Water from the Hydraulic Fracturing of Oil – Shale - DCN CWT00039	This presentation provides treatment performance data for electrocoagulation along with flowback pollutant concentrations for various shale plays.	Report	Ecolotron Water Recovery Systems	01/01/2012	Ecolotron Water Recovery Systems. 2012. Treatment of Flow Back and Produced Water from the Hydraulic Fracturing of Oil – Shale.	Centralized Waste Treaters	4	No	Yes	CWT00039
1.1	EPA-HQ-OW-2015-0665-0557	CARES McKean - DCN CWT00040	This website provides location information for a CWT that uses evaporation/distillation to treat shale gas wastewater in the Marcellus.	Publication; Copyrighted Material	CARES	01/28/2013	CARES. 2013. CARES McKean. Altela Rain.	Centralized Waste Treaters	2	No	Yes	CWT00040
1.1	EPA-HQ-OW-2015-0665-0558	Red Desert: Facilities - DCN CWT00042	This website provides general treatment information and the location for a CWT located in Wyoming.	Publication; Copyrighted Material	Red Desert	01/28/2013	Red Desert. 2013. Red Desert: Facilities. Available online at: http://reddesertwater.com/facilities.html. Downloaded on 28 January 2013.	Centralized Waste Treaters	5	No	Yes	CWT00042

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1.1	EPA-HQ-OW-2015-0665-0559	Evaluation of the Aqua Pure Mechanical Vapor Recompression System in the Treatment of Shale Gas Flowback Water Report No. 08122-05.11 - DCN CWT00043	This report provides information on evaporation/condensation as a treatment technology for flowback.	Report	Hayes, Thomas; et al	03/12/2012	Hayes, Thomas; et al. 2012. Evaluation of the Aqua Pure Mechanical Vapor Recompression System in the Treatment of Shale Gas Flowback Water. RPSEA.	Centralized Waste Treaters	43	No	No	CWT00043
1.1	EPA-HQ-OW-2015-0665-0560	Gas Well Drilling Brine Treatment Facility Opens in Fairmont - AOP Clearwater LLC is set to begin operation of its gas well drilling brine recycling facility in Fairmont - DCN CWT00044	Gas Well Drilling Brine Treatment Facility Opens in Fairmont	Fact/Data Sheet	Kasey, Pam	11/19/2009	Kasey, Pam. 2009. Gas Well Drilling Brine Treatment Facility Opens in Fairmont. The State Journal.	Centralized Waste Treaters	2	No	No	CWT00044
1.1	EPA-HQ-OW-2015-0665-0561	Summary of the Technical Workshop on Wastewater Treatment and Related Modeling - DCN CWT00045	This document summarizes the April 18, 2013 Workshop studying potential impacts of hydraulic fracturing on drinking water resources.	Publication; USEPA	U.S. EPA	04/18/2013	U.S. EPA. 2013. Summary of the Technical Workshop on Wastewater Treatment and Related Modeling. (April 18).	Centralized Waste Treaters	135	No	No	CWT00045

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1.1	EPA-HQ-OW-2015-0665-0563	H2OForward Service - Sustainable Development of Completions - DCN CWT00048	A presentation which discusses produced water recycling treatment options.	Publication; Copyrighted Material	Dale, Walter	10/29/2013	Dale, Walter. 2013. H2OForward Service - Sustainable Development of Completions. Multi-Chem - A Halliburton Service.	Centralized Waste Treaters	41	No	Yes	CWT00048
1.1	EPA-HQ-OW-2015-0665-0564	Strategies for Sustainable Water Transport Lessons Learned in the Marcellus Applied to the Niobrara - DCN CWT00049	A presentation that discusses water transportation and treatment options.	Publication; Copyrighted Material	Wilkerson, Tommy	10/30/2013	Wilkerson, Tommy. 2013. Strategies for Sustainable Water Transport Lessons Learned in the Marcellus Applied to the Niobrara. Carrizo Oil & Gas, Inc.	Centralized Waste Treaters	21	No	No	CWT00049
1.1	EPA-HQ-OW-2015-0665-0594	Unconventional Oil and Gas Wastewater Treatment Technologies DCN CWT00051	This report describes wastewater treatment technologies used by the UOG industry.	Publication; USEPA	U.S. EPA	06/01/2016	U.S. EPA. 2016. Unconventional Oil & Gas Wastewater Treatment Technologies. U.S. EPA Office of Water, Engineering and Analysis Division.	Centralized Waste Treaters	123	No	No	CWT00051

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1.1	EPA-HQ-OW-2015-0665-0594.1	Unconventional Oil and Gas Wastewater Treatment Technologies - Attachment 1: Treatment Technology Costs Spreadsheet DCN CWT00051.A1	This attachment contains information about the treatment technologies and associated costs compiled in the report	Publication; USEPA	U.S. EPA	06/01/2016	U.S. EPA. 2016. UOG WW Treatment Technologies - Attachment 1: Treatment Technology Costs Spreadsheet.	Centralized Waste Treaters	1	No	No	CWT00051.A1
1.1	EPA-HQ-OW-2015-0665-0595	Development Document for Proposed Effluent Limitations Guidelines and Standards for the Centralized Waste Treatment Industry - DCN CWT00053	EPA Document EPA-821-R-98-020. EPA's Development Document for Proposed ELGS for the Centralized Waste Treatment Industry. Includes information on data collection, scope and application of the proposed rule, description of the CWT industry, pollutants, etc	Publication; USEPA	U.S. EPA	12/01/1998	U.S. EPA. 1998. Development Document for Proposed Effluent Limitations Guidelines and Standards for the Centralized Waste Treatment Industry.	Centralized Waste Treaters	406	No	No	CWT00053
1.1	EPA-HQ-OW-2015-0665-0597	The Real Cost of ZLD for Shale Gas Frac Water in the Marcellus Shale Play - DCN CWT00055	Conference Proceedings describing of the true costs of a complete zero liquid discharge (ZLD) solution for the Marcellus Shale frac water by focusing on the chemistry of frac water.	Report	Shaw, William A.	09/01/2011	Shaw, William A. 2011. The Real Cost of ZLD for Shale Gas Frac Water in the Marcellus Shale Play. HPD, LLC. Veolia Water Solutions & Technologies.	Centralized Waste Treaters	14	No	No	CWT00055

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1.1	EPA-HQ-OW-2015-0665-0598	212 Resources VACOM Technology - DCN CWT00056	Barry Mertz explained the system design overview of the VACOM, characteristics of the concentrated brine, Energy usage, and ball park costs for evaporation in general.	Meeting/Teleconference Materials	Mertz, Barry	10/14/2011	Mertz, Barry. 2011. 212 Resources VACOM Technology. 212 Resources.	Centralized Waste Treaters	3	No	No	CWT00056
1.1	EPA-HQ-OW-2015-0665-0599	GE Power and Water Wastewater Treatment Technologies - DCN CWT00057	A teleconference between Mark Wilson and Brent Ruminski. The discussion covered general shale gas industry background including NORM, wastewater management, and trucking. Wilson also provided his thoughts on evaporation and crystallization technologies.	Meeting/Teleconference Materials	Wilson, Mark	11/10/2011	Wilson, Mark. 2011. GE Power and Water Wastewater Treatment Technologies. GE Power and Water.	Centralized Waste Treaters	3	No	No	CWT00057
1.1	EPA-HQ-OW-2015-0665-0600	EVRAS Evaporation Technology - DCN CWT00058	A teleconference call with a sales manager from INTEVRAS discussing a crystallization/evaporation wastewater treatment technology for shale gas operators.	Meeting/Teleconference Materials	Adams, Andy	09/26/2011	Adams, Andy. 2011. EVRAS Evaporation Technology. Intevras & Layne Water. (September 26).	Centralized Waste Treaters	1	No	No	CWT00058

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1.1	EPA-HQ-OW-2015-0665-0601	Siemens Reverse Osmosis Technology - DCN CWT00059	A teleconference call with engineers from Siemens discussing reverse osmosis as a wastewater treatment technology for shale gas operators.	Meeting/Teleconference Materials	Alexander, Jerry	09/28/2011	Alexander, Jerry. 2011. Siemens Reverse Osmosis Technology. Siemens. (September 28).	Centralized Waste Treaters	4	No	No	CWT00059
1.1	EPA-HQ-OW-2015-0665-0602	Fountain Quail NOMAD Evaporator - DCN CWT00060	Jaime and Brent Discussed the NOMAD evaporator (mechanical vapor compression). Jaime provided general information on energy usage, water recovery, and required pretreatment for the NOMAD evaporator.	Meeting/Teleconference Materials	Roman, Jaime	10/26/2011	Roman, Jaime. 2011. Fountain Quail NOMAD Evaporator. Fountain Quail. (October 26).	Centralized Waste Treaters	2	No	No	CWT00060
1.1	EPA-HQ-OW-2015-0665-1026	Unconventional Oil and Gas (UOG) Produced Water Volumes and Characterization Data Compilation - DCN CWT00061	This memorandum describes methodology for compiling wastewater volumes and characterization data in the Technical Development Document (TDD).	Memorandum	ERG	06/01/2016	ERG. 2016. Unconventional Oil and Gas (UOG) Produced Water Volumes and Characterization Data Compilation Memorandum	Centralized Waste Treaters	68	No	No	CWT00061

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1.1	EPA-HQ-OW-2015-0665-1026.01	Unconventional Oil and Gas (UOG) Produced Water Volumes and Characterization Data Compilation - Attachment 1: UOG PW Data Compilation - DCN CWT00061.A1	UOG Produced Water Data Compilation. Underlying data for TDD Tables C-6, C-7, and C-8	Data	ERG	06/01/2016	ERG. 2016. Unconventional Oil and Gas (UOG) Produced Water Volumes and Characterization Data Compilation —A01: UOG Produced Water Data Compilation.	Centralized Waste Treaters	7	No	No	CWT00061.A01
1.1	EPA-HQ-OW-2015-0665-1026.02	Unconventional Oil and Gas (UOG) Produced Water Volumes and Characterization Data Compilation - Attachment 2: DI Desktop Long-term Produced Water Generation Rates - DCN CWT00061.A2	ERG analysis of DI Desktop data to tabulate long-term produced water generation rates on a per well basis	Data	ERG	06/01/2016	ERG. 2016. UOG Produced Water Volumes and Characterization Data Compilation - A02: DI Desktop Long-term Produced Water Rates	Centralized Waste Treaters	3	No	No	CWT00061.A02
1.1	EPA-HQ-OW-2015-0665-1026.03	CBI_Unconventional Oil and Gas (UOG) Produced Water Volumes and Characterization Data Compilation - Attachment 3: DI Desktop Long-term Produced Water Generation Rates - DCN CWT00061.A3	CBI_Access database with DI Desktop long term produced water generation rate data	Data	ERG	06/01/2016	ERG. 2016. UOG Produced Water Volumes and Characterization Data Compilation—A03: DI Desktop Long-term Produced Water Rates_CBI.	Centralized Waste Treaters	1	Yes	Yes	CWT00061.A03

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1.1	EPA-HQ-OW-2015-0665-1026.04	Unconventional Oil and Gas (UOG) Produced Water Volumes and Characterization Data Compilation - Attachment 4: FracFocus Fracturing Fluid Volumes - DCN CWT00061.A4	FracFocus fracturing fluid volumes data	Data	ERG	06/01/2016	ERG. 2016. Unconventional Oil and Gas (UOG) Produced Water Volumes and Characterization Data Compilation—A04: FracFocus Fracturing Fluid Volume	Centralized Waste Treaters	4	No	No	CWT00061.A04
1.1	EPA-HQ-OW-2015-0665-1026.05	CBI_Unconventional Oil and Gas (UOG) Produced Water Volumes and Characterization Data Compilation - Attachment 5: FracFocus Fracturing Fluid Volumes - DCN CWT00061.A5	CBI_Access database with FracFocus fracturing fluid volume data. This is proprietary data, so it is being handled as CBI	Data	ERG	06/01/2016	ERG. 2016. Unconventional Oil and Gas (UOG) Produced Water Volumes and Characterization Data Compilation—A05: FracFocus Fracturing Fluid Volume_CBI.	Centralized Waste Treaters	1	Yes	Yes	CWT00061.A05
1.1	EPA-HQ-OW-2015-0665-1026.06	Unconventional Oil and Gas (UOG) Produced Water Volumes and Characterization Data Compilation - Attachment 6: Bakken Flowback Recovery - DCN CWT00061.A6	Bakken flowback volumes and raw data analysis.	Data	ERG	06/01/2016	ERG. 2016. Unconventional Oil and Gas (UOG) Produced Water Volumes and Characterization Data Compilation—A06: Bakken Flowback Water Rates	Centralized Waste Treaters	2	No	No	CWT00061.A06

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1.1	EPA-HQ-OW-2015-0665-1026.07	Unconventional Oil and Gas (UOG) Produced Water Volumes and Characterization Data Compilation - Attachment 7: New Mexico Flowback Recovery - DCN CWT00061.A7	New Mexico flowback water calculation and raw data analysis.	Data	ERG	06/01/2016	ERG. 2016. Unconventional Oil and Gas (UOG) Produced Water Volumes and Characterization Data Compilation—A07: New Mexico Flowback Water Rates.	Centralized Waste Treaters	2	No	No	CWT00061.A07
1.1	EPA-HQ-OW-2015-0665-1026.08	Unconventional Oil and Gas (UOG) Produced Water Volumes and Characterization Data Compilation - Attachment 8: Utica Produced Water Data - DCN CWT00061.A8	Flowback and long-term produced water volumes for horizontal wells in Ohio.	Data	ERG	06/01/2016	ERG. 2016. Unconventional Oil and Gas (UOG) Produced Water Volumes and Characterization Data Compilation—A08: Utica Flowback and Produced Water.	Centralized Waste Treaters	10	No	No	CWT00061.A08
1.1	EPA-HQ-OW-2015-0665-1026.09	Unconventional Oil and Gas (UOG) Produced Water Volumes and Characterization Data Compilation - Attachment 9: Wyoming Flowback Recovery - DCN CWT00061.A09	Wyoming shale flowback water calculation, raw data, and analysis.	Data	ERG	06/01/2016	ERG. 2016. Unconventional Oil and Gas (UOG) Produced Water Volumes and Characterization Data Compilation—A09: Wyoming Flowback Water Rates	Centralized Waste Treaters	3	No	No	CWT00061.A09

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1.1	EPA-HQ-OW-2015-0665-1026.10	Unconventional Oil and Gas (UOG) Produced Water Volumes and Characterization Data Compilation - Attachment 10: Codell-Niobrara Flowback Recovery and Long-term Produced Water Rates - DCN CWT00061.A10	Codell-Niobrara Flowback Recovery and Long-term Produced Water Rates	Data	ERG	06/01/2016	ERG. 2016. UOG Produced Water Volumes & Characterization Data Compilation—A10: Codell-Niobrara Flowback Recovery and Long-term Produced Water Rates	Centralized Waste Treaters	2	No	No	CWT00061.A10
1.1	EPA-HQ-OW-2015-0665-1026.11	Unconventional Oil and Gas (UOG) Produced Water Volumes and Characterization Data Compilation - Attachment 11: Colorado Flowback Recovery - DCN CWT00061.A11	Colorado shale flowback water calculation and analysis.	Data	ERG	06/01/2016	ERG. 2016. Unconventional Oil and Gas (UOG) Produced Water Volumes and Characterization Data Compilation—A11: Colorado Flowback Water Rates.	Centralized Waste Treaters	2	No	No	CWT00061.A11
1.1	EPA-HQ-OW-2015-0665-1026.12	Unconventional Oil and Gas (UOG) Produced Water Volumes and Characterization Data Compilation - Attachment 12: UOG Wastewater Characterization Analysis - DCN CWT00061.A12	A spreadsheet with analyses of UOG wastewater characterization	Data	ERG	06/01/2016	ERG. 2016. UOG Produced Water Volumes and Characterization Data Compilation - A12: UOG Wastewater Characterization Analysis	Centralized Waste Treaters	18	No	No	CWT00061.A12

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1.1	EPA-HQ-OW-2015-0665-1026.13	Unconventional Oil and Gas (UOG) Produced Water Volumes and Characterization Data Compilation - Attachment 13: UOG Wastewater Characterization Database - DCN CWT00061.A13	A database with analyses of UOG wastewater characterization	Data	ERG	06/01/2016	ERG. 2016. UOG Produced Water Volumes and Characterization Data Compilation - A13: UOG Wastewater Characterization Database	Centralized Waste Treaters	1	No	No	CWT00061.A13
1.1	EPA-HQ-OW-2015-0665-1026.14	Unconventional Oil and Gas (UOG) Produced Water Volumes and Characterization Data Compilation - Attachment 14: USGS Produced Water Database - DCN CWT00061.A14	A spreadsheet with analyses from the US Geological Survey produced water database	Data	ERG	06/01/2016	ERG. 2016. Unconventional Oil and Gas (UOG) Produced Water Volumes and Characterization Data Compilation - A14: USGS Produced Water Database	Centralized Waste Treaters	5	No	No	CWT00061.A14
1.1	EPA-HQ-OW-2015-0665-1026.15	Unconventional Oil and Gas (UOG) Produced Water Volumes and Characterization Data Compilation - Attachment 15: USGS Produced Water Database - DCN CWT00061.A15	The produced water database from the US Geological Survey	Data	ERG	06/01/2016	ERG. 2016. Unconventional Oil and Gas (UOG) Produced Water Volumes and Characterization Data Compilation - A15: USGS Produced Water Database	Centralized Waste Treaters	1	No	No	CWT00061.A15

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1.1	EPA-HQ-OW-2015-0665-1026.16	CBI_Unconventional Oil and Gas (UOG) Produced Water Volumes and Characterization Data Compilation - Attachment 16: ORD Non-CBI Operator Data - DCN CWT00061.A16	CBI_A database of non-CBI operator data from the Office of Research and Development. This is proprietary data and is being treated as CBI.	Data	ERG	06/01/2016	ERG. 2016. Unconventional Oil and Gas (UOG) Produced Water Volumes and Characterization Data Compilation - A16: ORD Non-CBI Operator Data_CBI.	Centralized Waste Treaters	1	Yes	Yes	CWT00061.A16
1.1	EPA-HQ-OW-2015-0665-1026.17	Unconventional Oil and Gas (UOG) Produced Water Volumes and Characterization Data Compilation - Attachment 17: WY OGCC Database - DCN CWT00061.A17	A spreadsheet with analyses from the WY OGCC produced water database	Data	ERG	06/01/2016	ERG. 2016. Unconventional Oil and Gas (UOG) Produced Water Volumes and Characterization Data Compilation - A17: WY OGCC Database.	Centralized Waste Treaters	1	No	No	CWT00061.A17
1.1	EPA-HQ-OW-2015-0665-1026.18	Unconventional Oil and Gas (UOG) Produced Water Volumes and Characterization Data Compilation - Attachment 18: WY OGCC Excel Calculations - DCN CWT00061.A18	Excel functions to calculate the median values and number of samples for each unique Basin, Formation, and Parameter in the WY OGCC database.	Data	ERG	06/01/2016	ERG. 2016. Unconventional Oil and Gas (UOG) Produced Water Volumes and Characterization Data Compilation - A18: WY OGCC Excel Calculations.	Centralized Waste Treaters	1	No	No	CWT00061.A18

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1.1	EPA-HQ-OW-2015-0665-0618	Offsite Commercial Disposal of Oil and Gas Exploration and Production Waste: Availability, Options, and Costs - DCN CWT00097	In 2005, DOE tasked Argonne with updating the data concerning offsite exploration and production (E&P) waste disposal methods and costs. This report presents Argonne's findings.	Report	Puder, M.G., and J.A. Veil	08/01/2006	Puder, M.G. and J.A. Veil. 2006. Offsite Commercial Disposal of O&G E&P Waste: Availability, Options, and Costs. Argonne National Laboratory.	Centralized Waste Treaters	148	No	No	CWT00097
1.1	EPA-HQ-OW-2015-0665-0619	Design of a Mobile Wastewater Treatment System for Hydraulic Fracturing Waste - DCN CWT00099	The team designed a system to treat the contaminated water produced by hydraulic fracturing of shale rock for natural gas. We did so by combining and optimizing several current treatment technologies to produce a mobile-scale process.	Report	Marc Panu, Matthew Claussen and Faiz Talib	04/19/2013	Marc Panu, Matthew Claussen and Faiz Talib. 2013. Design of a Mobile Wastewater Treatment System for Hydraulic Fracturing Waste. Chevron Group.	Centralized Waste Treaters	53	No	No	CWT00099
1.1	EPA-HQ-OW-2015-0665-0622	Taking a Proactive Approach to Water Recycling in the Barnett Shale - DCN CWT00104	This presentation provides Devon overview and current activity, Overview of two waste waters in the Barnett, Devon's proactive approach to water recycling and future activity in water recycling.	Meeting or Teleconference Materials	Jay Ewing	02/29/2008	Jay Ewing. 2008. Taking a Proactive Approach to Water Recycling in the Barnett Shale. Devon Energy.	Centralized Waste Treaters	30	No	No	CWT00104

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1.1	EPA-HQ-OW-2015-0665-0623	Welcome to Purestream Technology - DCN CWT00106	A privately held R&D company providing a suite of patented environmental solutions focused on the treatment of wastewater, air emissions, renewable energy and data tracking.	Fact/Data Sheet	Purestream Technology	01/01/2011	Purestream Technology. 2011. Welcome to Purestream Technology. http://purestreamtechnology.com/downloads/purestream-technology-overview-2011.pdf.	Centralized Waste Treaters	47	No	No	CWT00106
1.1	EPA-HQ-OW-2015-0665-0569	Small Entity Compliance Guide: Centralized Waste Treatment Effluent Limitations Guidelines and Pretreatment Standards - DCN CWT00144	This document is published by the U.S. Environmental Protection Agency (EPA) as our official compliance guide for small entities, as required by the Small Business Regulatory Enforcement Fairness Act of 1996. (EPA 821-B-01-003)	Publication; USEPA	U.S. EPA	06/01/2001	U.S.EPA. 2011. Small Entity Compliance Guide: Centralized Waste Treatment Effluent Limitations Guidelines & Pretreatment Standards. EPA-821-B-01-003.	Centralized Waste Treaters	81	No	No	CWT00144
1.1	EPA-HQ-OW-2015-0665-0574	Oil and Gas Produced Water Management and Beneficial Use in the Western United States - DCN CWT00157	Produced water from oil and gas operations is currently handled as a waste product.	Report	Katie Guerra, Katharine Dahm, Steve Dundor	09/01/2011	U.S. DOI. 2011. Katie Guerra, Katharine Dahm, and Steve Dundorf. Oil and Gas Produced Water Management and Beneficial Use in the Western United States	Centralized Waste Treaters	129	No	No	CWT00157

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1.1	EPA-HQ-OW-2015-0665-0575	Produced Water Volumes and Management Practices in 2012. - DCN CWT00158	This new report updates and expands the 2009 report to provide a current estimate for the volume of produced water generated from all onshore and offshore oil and gas production in the United States during the 2012 calendar year. The volume estimate repre	Report	Clark, C.E., and J.A. Veil	04/22/2015	22.U.S. GWPC. 2015. Clark, C.E., and J.A. Veil. U.S. Produced Water Volumes and Management Practices in 2012. (April).	Centralized Waste Treaters	119	No	No	CWT00158
1.1	EPA-HQ-OW-2015-0665-0576	Reuters Fundamentals: Big Cat Energy Corp - DCN CWT00170	With over 35 years' experience of collecting and publishing company fundamentals, Reuters covers 99% of the world's market cap.	Fact/Data Sheet	Reuters	01/01/2014	Reuters. 2014. Reuters Fundamentals: Big Cat Energy Corp. 11 July 2014. Accessed July 16, 2014.	Centralized Waste Treaters	2	No	No	CWT00170
1.1	EPA-HQ-OW-2015-0665-0577	Annual Energy Outlook 2014 with Projections to 2040 - DCN CWT00171	Presents long-term annual projections of energy supply, demand, and prices focused on the U.S. through 2040, based on results from EIA's National Energy Modeling System (NEMS).	Report	U.S. DOE	04/01/2014	United States Department of Energy (U.S. DOE). 2014. United States Energy Information Administration (EIA).	Centralized Waste Treaters	269	No	No	CWT00171

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1.1	EPA-HQ-OW-2015-0665-0578	Waste Management Acquires Two North Dakota Energy Services Companies - DCN CWT00172	Waste Management, Inc. (NYSE: WM) today announced that it has acquired Summit Energy Services and Liquid Logistics, two Williston, North Dakota energy services companies.	Press Release, Public Announcement/Notice	Jennifer Andrews	08/01/2013	Waste Management, Inc. 2013. "Waste Management Acquires Two North Dakota Energy Services Companies." August 1, 2013.	Centralized Waste Treaters	2	No	No	CWT00172
1.1	EPA-HQ-OW-2015-0665-0579	Eureka Resources- The First Step to Cleaner Waters - DCN CWT00174	Online Webpage for Eureka Resources and their oil and gas wastewater operations	Other	Eureka Resources	01/01/2016	Eureka Resources. 2016. Web. Accessed 28 April 2016. Available electronically at: http://eureka-resources.com/about-us/	Centralized Waste Treaters	2	No	No	CWT00174
1.1	EPA-HQ-OW-2015-0665-0580	U.S. rig count hits all-time low in recorded data - DCN CWT00184	The overall weekly US rig count is now at its lowest point in Baker Hughes Inc. data that begins in the 1940s, and perhaps since the infancy ofUS oil and gas industry.	Economic Analysis	Matt Zborowski	03/11/2016	Zborowski, Matt. 2016. "U.S. rig count hits all-time low in recorded data." Oil and Gas Journal.	Centralized Waste Treaters	3	No	No	CWT00184

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1.1	EPA-HQ-OW-2015-0665-0581	Anaerobic Membrane Bioreactor (ADI-AnMBR) - DCN CWT00185	Vendor profile for Anaerobic Membrane Bioreactor (ADI-AnMBR) by the ADI System Inc.	Fact/Data Sheet	ADI System Inc.	01/01/2015	ADI System Inc. 2015. Vendor Profile: Anaerobic Membrane Bioreactor (ADI-AnMBR)	Centralized Waste Treaters	3	No	Yes	CWT00185
1.1	EPA-HQ-OW-2015-0665-0583	Patented Evaporation & Crystallization Process - DCN CWT00191	Presentation from Shale Gas Innovation and Commercialization Center Technology Showcase	Data	Fairmont Brine Processing	01/01/2015	Fairmont Brine Processing. 2015. Presentation from Shale Gas Innovation and Commercialization Center Technology Showcase.	Centralized Waste Treaters	11	No	No	CWT00191
1.1	EPA-HQ-OW-2015-0665-0644	Short Term Energy Outlook April 2016 - DCN CWT00213	During the 2016 April-through-September summer driving season, U.S. regular gasoline retail prices are forecast to average $2.04/gallon (gal), compared with $2.63/gal last summer	Data	U.S. Energy Information Administration	01/01/2016	United States Department of Energy (U.S. DOE). 2016b. United States Energy Information Administration (EIA). Short Term Energy Outlook April 2016.	Centralized Waste Treaters	51	No	No	CWT00213

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1.1	EPA-HQ-OW-2015-0665-0646	North American Industry Classification System Search DCN CWT00217	The North American Industry Classification System website	Other	U.S Census Bureau	01/01/2016	United States Census Bureau (U.S. Census). 2016. North American Industry Classification System Search.	Centralized Waste Treaters	1	No	No	CWT00217
1.1	EPA-HQ-OW-2015-0665-0649	Natural Gas Gross Withdrawals and Production: Marketed Production DCN CWT00224	United States Energy Information Administration (EIA) Report on Natural Gas Gross Withdrawals and Production: Marketed Production	Data	U.S. DOE	01/01/2016	United States Department of Energy (U.S. DOE). 2016a. United States Energy Information Administration (EIA).	Centralized Waste Treaters	2	No	No	CWT00224
1.1	EPA-HQ-OW-2015-0665-0661	U.S. Crude Oil Production (Thousand barrels). DCN CWT00225	United States Energy Information Administration (EIA) Report on U.S. Crude Oil Production (Thousand barrels)	Data	U.S. DOE	01/01/2016	United States Department of Energy (U.S. DOE). 2016c. United States Energy Information Administration (EIA).	Centralized Waste Treaters	2	No	No	CWT00225

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1.1	EPA-HQ-OW-2015-0665-0666	U.S. Dry Shale Gas Production DCN CWT00226	United States Energy Information Administration (EIA) Report on U.S. Dry Shale Gas Production	Data	U.S. DOE	01/01/2016	United States Department of Energy (U.S. DOE). 2016d. United States Energy Information Administration (EIA).	Centralized Waste Treaters	5	No	No	CWT00226
1.1	EPA-HQ-OW-2015-0665-0671	Hoover's Database DCN CWT00228	Allows access to the largest commercial database of 85 million companies, 100 million professionals, and 900 industry segments; relevant social media links; and customizable news feeds	Data	Dun & Bradstreet (D&B)	01/01/2016	Dun & Bradstreet (D&B). 2016. Hoover's Database. Available electronically at: www.hoovers.co m.	Centralized Waste Treaters	2	No	No	CWT00228
1.1	EPA-HQ-OW-2015-0665-0672	Annual Energy Outlook 2015 with Projections to 2040 DCN CWT00229	United States Energy Information Administration (EIA) Report on Annual Energy Outlook 2015 with Projections to 2040.	Data	U.S DOE	01/01/2015	United States Department of Energy (U.S. DOE). 2015. United States Energy Information Administration (EIA).	Centralized Waste Treaters	269	No	No	CWT00229

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1.1	EPA-HQ-OW-2015-0665-0676	Vendor Profile: Aquatech - DCN CWT00231	A profile of the company AquaTech, which provides water purification technologies for industrial and infrastructure markets, with a focus on desalination, water reuse, and zero liquid discharge.	Publication; Copyrighted Materials	ALL Consulting	01/01/2011	ALL Consulting. 2011. Vendor Profile: AquaTech.	Centralized Waste Treaters	1	No	No	CWT00231
1.1	EPA-HQ-OW-2015-0665-0677	Vendor Profile: GeoPure Hydrotechnologies - DCN CWT00232	A profile of the commercial stage, full service provider GeoPure Hydrotechnologies, which focuses on contaminated water recycling and purification rather than disposal.	Publication; Copyrighted Materials	ALL Consulting	01/01/2011	ALL Consulting. 2011. Vendor Profile: GeoPure Hydrotechnologie s.	Centralized Waste Treaters	1	No	No	CWT00232
1.1	EPA-HQ-OW-2015-0665-0678	Vendor Profile: INTEVRAS Technologies, LLC - DCN CWT00233	A profile of the industrial waste water treatment company INTEVRAS Technologies LLC, which focuses on waste water reduction, crystallization, and freshwater extraction using evaporative reduction and solidification.	Publication; Copyrighted Materials	ALL Consulting	01/01/2011	ALL Consulting. 2011. Vendor Profile: INTEVRAS Technologies, LLC.	Centralized Waste Treaters	1	No	No	CWT00233

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1.1	EPA-HQ-OW-2015-0665-0679	Vendor Profile: MI SWACO - DCN CWT00234	A profile of the supplier/engineering designer of drilling fluid systems MI SWACO.	Publication; Copyrighted Materials	ALL Consulting	01/01/2011	ALL Consulting. 2011. Vendor Profile: MISWACO.	Centralized Waste Treaters	2	No	No	CWT00234
1.1	EPA-HQ-OW-2015-0665-0680	Vendor Profile: Veolia Water Solutions & Technologies - DCN CWT00235	A profile of the water and wastewater treatment company NA Water Systems, a technical subsidiary of Veolia Water Solutions and Technology.	Publication; Copyrighted Materials	ALL Consulting	01/01/2011	ALL Consulting. 2011. Vendor Profile: Veolia.	Centralized Waste Treaters	1	No	No	CWT00235
1.1	EPA-HQ-OW-2015-0665-0681	Fact Sheet To Permit Number Co0048739 Bopco, L.P., Yellow Creek Water Management Facility Rio Blanco County - DCN CWT00236	A factsheet providing supplemental information about permit number CO0048739, including information about the receiving stream, facility, performance history, effluent limitations, and terms and conditions.	Fact/Data Sheet	Colorado Department of Public Health	01/10/2011	CO Department Of Public Health And Env. 2011. CDPS Fact Sheet To Permit Number Co0048739 Bopco, L.P., Yellow Creek Water Mgmt Facility Rio Blanco Co.	Centralized Waste Treaters	23	No	No	CWT00236

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1.1	EPA-HQ-OW-2015-0665-0682	Frac Water: Treating Flowback and Produced Water for Re-Use - DCN CWT00237	A website describing the produced water services Omni Water Solutions provides.	Publication; Copyrighted Materials	Omni Water Solutions	01/14/2014	Omni Water Solutions. 2014. Frac Water. Treating Flowback and Produced Water for Re-Use.	Centralized Waste Treaters	2	No	No	CWT00237
1.1	EPA-HQ-OW-2015-0665-0683	AltelaRain System ARS-4000 - DCN CWT00238	A brochure for the ARS-4000 AltelaRain System.	Publication	ALTELA	01/01/2011	ALL Consulting. 2011. Vendor Profile: Altela	Centralized Waste Treaters	2	No	No	CWT00238
1.1	EPA-HQ-OW-2015-0665-0684	MoVap: Mobile Water Distillation System - DCN CWT00239	A fact sheet on the MoVap mobile solution to treat flowback water on-site.	Publication; Copyrighted Materials	AquaTech International Corporation	01/01/2011	AquaTech International Corporation. 2011. Mobile Water Distillation System. Online at: http://www.aquatech.com/portals/0/MoVap%20Cut%20Sheet-01.pdf	Centralized Waste Treaters	1	No	No	CWT00239

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1.1	EPA-HQ-OW-2015-0665-0685	Frac Water Reclamation System Reduces Operator's Water Cost - DCN CWT00240	A performance report which describes how the M-I SWACO Frac Water Reclamation system reduced costs.	Publication; Copyrighted Materials	M-I SWACO	01/01/2009	M-I SWACO. 2009. Frac Water Reclamation System Reduces Operator's Water Cost.	Centralized Waste Treaters	3	No	No	CWT00240
1.1	EPA-HQ-OW-2015-0665-0688	Produced and Flowback Water Recycling and Reuse: Economics, Limitations, and Technology DCN CWT00242	Article about UOG wastewater recycling and reuse throughout the U.S.	Study	Boschee, Pam	02/01/2014	Boschee, Pam. 2014. Produced and Flowback Water Recycling and Reuse: Economics, Limitations, and Technology. (February).	Centralized Waste Treaters	6	No	No	CWT00242
1.1	EPA-HQ-OW-2015-0665-0691	Gradiant: Operations DCN CWT00247	Gradiant designed, built, and operates two 12,000 bpd plants in the Permian basin. Both treat produced and flowback waters.	Press Release, Public Announcement/Notice	Gradiant	01/01/2016	Gradiant. 2016. Gradiant: Operations. www.gradiant.com/operations.	Centralized Waste Treaters	1	No	No	CWT00247

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1.1	EPA-HQ-OW-2015-0665-0707	CWT facilities operating in New York DCN CWT00259	Centralized Waste Treatment Facilities in New York.	Fact/Data Sheet				Centralized Waste Treaters	2	No	No	CWT00259
1.1	EPA-HQ-OW-2015-0665-1068	Water Resource Reporting and Water Footprint from Marcellus Shale Development in West Virginia and Pennsylvania - DCN CWT00336	This report documents water withdrawals, fluid injections, and waste recovery and disposal in West Virginia and Pennsylvania.	Publication; Copyrighted Material	Hansen; et al	10/30/2013	Hansen, E; Mulvaney, D; Betcher, M. 2013. Water Resource Reporting and Water Footprint from Marcellus Shale Development in WV and PA. (October 30).	Centralized Waste Treaters	88	No	Yes	CWT00336
1.1	EPA-HQ-OW-2015-0665-0974	Fracking & Associated Media Composition in Colorado - DCN CWT00338	A presentation on fracking and associated media composition in CO.	Publication; Copyrighted Material	Havics, Andrew	01/01/2011	Havics, Andrew, pH2, LLC/QEPA. 2011. Fracking & Associated Media Composition in Colorado	Centralized Waste Treaters	18	No	Yes	CWT00338

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1.1	EPA-HQ-OW-2015-0665-0593	Produced Water Volumes and Management Practices in the United States - DCN CWT00358	Current estimate for the volume of produced water generated from oil and gas production in the United States. The volume estimate represents a compilation of data obtained from numerous state oil and gas agencies and several federal sources.	Report	Clark, C.E.; Veil, J.A.	09/01/2009	Clark, C.E.; Veil, J.A. 2009. Produced Water Volumes and Management Practices in the United States. ANL/EVS/R-09/1. Argonne National Laboratory.	Centralized Waste Treaters	65	No	No	CWT00358
1.1	EPA-HQ-OW-2015-0665-0652	Marcellus Shale Gas Development and Water Resource Issues DCN CWT00361	Presentation about water resource use and drilling processes in Marcellus	Report	Williams, John	06/28/2011	Williams, John. 2011. Marcellus Shale-Gas Development and Water-Resource Issues. USGS: New York Water Science Center.	Centralized Waste Treaters	23	No	No	CWT00361
1.1	EPA-HQ-OW-2015-0665-0653	The Marcellus Shale Gas Play: Geology, Development, and Water Resource Impact Mitigation - DCN CWT00362	This presentation describes the geology, development, and impact on water-resources of hydraulic fracturing in the Marcellus shale.	Meeting or Teleconference Materials	Williams, John		Williams, John. n.d. The Marcellus Shale Gas Play: Geology, Development, and Water-Resource Impact Mitigation. USGS: New York Water Science Center.	Centralized Waste Treaters	61	No	No	CWT00362

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1.2	EPA-HQ-OW-2015-0665-0633	U.S. Geological Survey National Produced Waters Geochemical Database v2.1 (PROVISIONAL) - Documentation - DCN CWT00129	Documentation on USGS's national produced waters geochemical database v2.1 (provisional).	Report	U.S. Geological Survey (USGS)	10/16/2014	U.S. Geological Survey (USGS). 2014. National Produced Waters Geochemical Database v2.1 (Provisional) - Documentation.	Centralized Waste Treaters	15	No	No	CWT00129
1.2	EPA-HQ-OW-2015-0665-0686	Technologically Enhanced Naturally Occurring Radioactive Materials (TENORM) Study Report Rev 1 - DCN CWT00131	Study of radioactivity exposure to workers who work with oil and gas extraction wastewater	Report	Pennsylvania Department of Environmental P	05/01/2016	PA DEP. 2016. Technologically Enhanced Naturally Occurring Radioactive Materials (TENORM) Study Report. Rev 1.	Centralized Waste Treaters	200	No	No	CWT00131
1.2	EPA-HQ-OW-2015-0665-0686.01	APPENDIX A ADDITIONAL GEOLOGICAL INFORMATION - DCN CWT00131.A1	PA DEP TENORM Report Additional geological information for Marcellus shale and other shale formations in Pennsylvania. Includes rock formation sample analyses.	Report	Pennsylvania Department of Environmental P	05/01/2016	PA DEP. 2016. APPENDIX A ADDITIONAL GEOLOGICAL INFORMATION –GEOLOGY OF MARCELLUS SHALE ANDOTHER PENNSYLVANIA SHALE FORMATIONS.	Centralized Waste Treaters	14	No	No	CWT00131.A01

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1.2	EPA-HQ-OW-2015-0665-0686.02	APPENDIX B FIELD INSTRUMENTATION QC DOCUMENTATION - DCN CWT00131.A2	PA DEP TENORM Report Field instrumentation quality control documentation.	Report	Pennsylvania Department of Environmental P	05/01/2016	PA DEP. 2015. APPENDIX B FIELD INSTRUMENTATION QC DOCUMENTATION.	Centralized Waste Treaters	54	No	No	CWT00131.A02
1.2	EPA-HQ-OW-2015-0665-0686.03	APPENDIX C GAMMA SPECTROSCOPY ANALYTICAL RESULTS - DCN CWT00131.A3	PA DEP TENORM Report Gamma spectroscopy analytical results for drill cuttings, proppant sand, flowback solids and fluids, produced waters, POTW solids and fluids, CWT effluent, ZLD solids and effluent, landfill leachate and bulking solids, and background.	Report	Pennsylvania Department of Environmental P	05/01/2016	PA DEP. 2016. APPENDIX C GAMMA SPECTROSCOPY ANALYTICAL RESULTS.	Centralized Waste Treaters	101	No	No	CWT00131.A03
1.2	EPA-HQ-OW-2015-0665-0686.04	APPENDIX D TOTAL AND REMOVABLE ALPHA/BETA SURFACE RADIOACTIVITY RESULTS - DCN CWT00131.A4	PA DEP TENORM Report Total and removable alpha/beta surface radioactivity results for well sites.	Report	Pennsylvania Department of Environmental P	05/01/2016	PA DEP. 2016. APPENDIX D TOTAL AND REMOVABLE ALPHA/BETA SURFACE RADIOACTIVITY RESULTS.	Centralized Waste Treaters	165	No	No	CWT00131.A04

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1.2	EPA-HQ-OW-2015-0665-0686.05	APPENDIX E GROSS GAMMA RADIATION SURVEY FIGURES - DCN CWT00131.A5	PA DEP TENORM Report Gross gamma radiation survey figures for well sites.	Report	Pennsylvania Department of Environmental P	05/01/2016	PA DEP. 2016. APPENDIX E GROSS GAMMA RADIATION SURVEY FIGURES.	Centralized Waste Treaters	88	No	No	CWT00131.A05
1.2	EPA-HQ-OW-2015-0665-0686.06	APPENDIX F XRF ANALYTICAL ANALYSES RESULTS - DCN CWT00131.A6	PA DEP TENORM Report Solid and Liquid XRF analytical analysis results.	Report	Pennsylvania Department of Environmental P	05/01/2016	PA DEP. 2016. APPENDIX F XRF ANALYTICAL ANALYSES RESULTS.	Centralized Waste Treaters	41	No	No	CWT00131.A06
1.2	EPA-HQ-OW-2015-0665-0686.07	APPENDIX G T-TEST OUTPUT FILES - DCN CWT00131.A07	PA DEP TENORM Report T-test output files.	Report	Pennsylvania Department of Environmental P	05/01/2016	PA DEP. 2016. APPENDIX G T-TEST OUTPUT FILES.	Centralized Waste Treaters	30	No	No	CWT00131.A07

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1.2	EPA-HQ-OW-2015-0665-0686.08	Appendix H Radon Monitor-Sample Analytical Analyses Reports - DCN CWT00131.A8	PA DEP TENORM Report Radon monitoring analytical analysis reports.	Report	Pennsylvania Department of Environmental P	05/01/2016	PA DEP. 2016. Appendix H Radon Monitor-Sample Analytical Analyses Reports.	Centralized Waste Treaters	159	No	No	CWT00131.A08
1.2	EPA-HQ-OW-2015-0665-0686.09	APPENDIX I FILTERED VERSUS UNFILTERED LIQUID SAMPLE COMPARISON - DCN CWT00131.A9	PA DEP TENORM Report Evaluation of the effects of laboratory filtering on sample activity for CWT, ZLD, POTW, and produced water samples from well sites.	Report	Pennsylvania Department of Environmental P	05/01/2016	PA DEP. 2016. APPENDIX I FILTERED VERSUS UNFILTERED LIQUID SAMPLE COMPARISON.	Centralized Waste Treaters	46	No	No	CWT00131.A09
1.2	EPA-HQ-OW-2015-0665-0686.10	APPENDIX J MICROSHIELD® OUTPUT FILES - DCN CWT00131.A10	PA DEP TENORM Report Microshield output files for the following scenarios: wastewater truck driver with 3,800 gallons at the DOT limit, solid waste roll-off at the DOT limit, and solid waste container on Day 1, 3, 10, 21, and 28.	Report	Pennsylvania Department of Environmental P	05/01/2016	PA DEP. 2016. APPENDIX J MICROSHIELD® OUTPUT FILES.	Centralized Waste Treaters	23	No	No	CWT00131.A10

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1.2	EPA-HQ-OW-2015-0665-0686.11	Appendix K Laboratory Data Report - DCN CWT00131.A11	PA DEP TENORM Report Screen shot of the Appendix K Lab Data Report Screen for 2900-RE-DEP4478.	Report	Pennsylvania Department of Environmental P	05/01/2016	PA DEP. 2016. Appendix K Laboratory Data Report.	Centralized Waste Treaters	2	No	No	CWT00131.A11
1.2	EPA-HQ-OW-2015-0665-0686.12	APPENDIX L PEER REVIEW COMMENT AND RESOLUTION DOCUMENT - DCN CWT00131.A12	PA DEP TENORM Report Peer review comment and resolution table for the PA TENORM Study Report.	Report	Pennsylvania Department of Environmental P	05/01/2016	PA DEP. 2016. APPENDIX L PEER REVIEW COMMENT AND RESOLUTION DOCUMENT.	Centralized Waste Treaters	43	No	No	CWT00131.A12
1.2	EPA-HQ-OW-2015-0665-0686.13	Appendix M Non-Radiological Parameters - DCN CWT00131.A13	PA DEP TENORM Report Samples for various water quality parameters were collected from 44 different sources (44 data sets or samples). These sources were categorized as: hydraulic fracturing fluid, flowback water, production water, wastewater treatment inf	Report	Pennsylvania Department of Environmental P	05/01/2016	PA DEP. 2016. Appendix M Non-Radiological Parameters.	Centralized Waste Treaters	31	No	No	CWT00131.A13

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1.2	EPA-HQ-OW-2015-0665-0567	Development Document for Interim Final Effluent Limitations Guidelines and Proposed New Source Performance Standards for the Oil and Gas Extraction Point Source Category - DCN CWT00134	This development document presents the findings of an extensive study	Publication; USEPA	U.S. EPA	09/01/1976	U.S. EPA. 1976. Development Document Interim Final ELG & Proposed New Source Performance Standards for Oil and Gas Extraction Point Source Category.	Centralized Waste Treaters	156	No	No	CWT00134
1.2	EPA-HQ-OW-2015-0665-0639	DOE Projects to Advance Environmental Science and Technology - DCN CWT00207	National Energy Technology Laboratory's (NETL) primary goal is to enhance the responsible development of domestic natural gas and oil resources that supply the country's energy	Meeting or Teleconference Materials	U.S. DOE	01/01/2013	United States Department of Energy (U.S. DOE). 2013. DOE Projects to Advance Environmental Science and Technology.	Centralized Waste Treaters	3	No	No	CWT00207
1.2	EPA-HQ-OW-2015-0665-0641	Flowback (Wastewater) from Hydraulic Fracturing - DCN CWT00210	An article on Ohio's 80,000 oil and gas wells and their completion process	Guidance, Interpretation, Policy, Procedure	Ohio DNR		Ohio Department of Natural Resources (Ohio DNR). Uknown. Flowback (Wastewater) from Hydraulic Fracturing. Accessed 28 April 2016.	Centralized Waste Treaters	1	No	No	CWT00210

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1.2	EPA-HQ-OW-2015-0665-0648	Regulatory Flexibility Act Section 610 Review of Effluent Limitations Guidelines and Standards for the Centralized Waste Treatment Industry DCN CWT00222	Section 610 Review of Effluent Limitations Guidelines and Standards for the Centralized Waste Treatment Industry	Guidance, Interpretation, Policy, Procedure	U.S. EPA	01/01/2010	U.S. EPA. 2010. Regulatory Flexibility Act Section 610 Review of CWT ELGs and Standards	Centralized Waste Treaters	17	No	No	CWT00222
1.2	EPA-HQ-OW-2015-0665-0708	Final 2014 Effluent Guidelines Program Plan DCN CWT00261	Summary of EPA's review of effluent guidelines and pretreatment standards, identification of industrial categories selected for rulemakings, and categories selected for further review	Publication; USEPA	U.S. EPA	07/01/2015	U.S. EPA. 2015. Final 2014 Effluent Guidelines Program Plan. Available online at: http://www2.epa.gov/eg/effluent-guidelines-plan-2014	Centralized Waste Treaters	50	No	No	CWT00261
1.2	EPA-HQ-OW-2015-0665-0734	MAX Environmental Technologies Inc NPDES Permit DCN CWT00305	NPDES authorization to discharge treated fluids from the exploration, production, and development of oil and/or gas operations.	Permit, Registration	Pennsylvania Department of Environmental P	07/28/2004	PA DEP. 2004. MAX Environmental Technologies Inc NPDES Permit. PA0027715.	Centralized Waste Treaters	33	No	No	CWT00305

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1.2	EPA-HQ-OW-2015-0665-0985	Revised Draft: Supplemental Generic Environmental Impact Statement (SGEIS) on the Oil, Gas, and Solution Mining Regulatory Program: Information Requests DCN CWT00349	Revised draft of the supplemental generic environmental impact statement on the oil, gas, and solution mining regulatory program.	Report	NYSDEC	09/07/2011	NYSDEC. 2011. Supplemental Generic Environmental Impact Statement (SGEIS) on the Oil, Gas, and Solution Mining Regulatory Program: Info Requests.	Centralized Waste Treaters	1537	No	No	CWT00349
1.3	EPA-HQ-OW-2015-0665-0528	Draft Toxic Weighting Factor Development in Support of CWA 304(m) Planning Process - DCN CWT00001	Discussion of the development of toxic weighting factors for pollutant to account for each pollutant having its own level of toxicity.	Report	ERG	07/29/2005	ERG. 2005. Draft Toxic Weighting Factor Development in Support of CWA 304(m) Planning Process. (July 29).	Centralized Waste Treaters	104	No	No	CWT00001
1.3	EPA-HQ-OW-2015-0665-0529	Coalbed Methane Extraction: Detailed Study Report - DCN CWT00002	This report summarizes the information collected and analyzed by the U.S. Environmental Protection Agency (EPA) as part of a study of the coalbed methane (CBM) extraction industry.	Publication; USEPA	U.S. EPA	12/01/2010	U.S. EPA. 2010. Coalbed Methane Extraction: Detailed Study Report. (December)	Centralized Waste Treaters	91	No	No	CWT00002

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1.3	EPA-HQ-OW-2015-0665-0531	Cost Effective Recovery of Low-TDS Frac Flowback Water for Reuse - DCN CWT00005	Document about the possibility of using low TDS fracturing flowback water in a cost effective manner.	Report	Acharya, Harish R.; GE Global Research	06/01/2011	Acharya, Harish R. 2011. Cost Effective Recovery of Low-TDS Frac Flowback Water for Reuse. GE Global Research. U.S. DOE NETL.	Centralized Waste Treaters	100	No	No	CWT00005
1.3	EPA-HQ-OW-2015-0665-0532	Water-Related Issues Associated with Gas Production in the Marcellus Shale - DCN CWT00006	Report discusses additives use, flowback quality and quantity, regulations, on-site treatment, green technologies, alternate water sources, and water well testing.	Report	URS	03/25/2011	URS. 2011. Water-Related Issues Associated with Gas Production in the Marcellus Shale. (March)	Centralized Waste Treaters	126	No	No	CWT00006
1.3	EPA-HQ-OW-2015-0665-0533	Cabot Gas Well Treated with 100% Reused Frac Fluid - DCN CWT00007	A case study on treating wastewater onsite and reusing for fracturing without dilution.	Publication; Copyrighted Material	Papso, John; Blauch, Matt; Grottenthaler,	08/01/2010	Papso, John; Blauch, Matt; Grottenthaler, Dave. 2010. Cabot Gas Well Treated with 100% Reused Frac Fluid. Cabot Oil and Gas Corp. (August)	Centralized Waste Treaters	6	No	Yes	CWT00007

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1.3	EPA-HQ-OW-2015-0665-0534	Water Reuse: An Integrated Approach to Managing the World's Water Resources. Chapter 9. Removal of Dissolved Constituents with Membranes - DCN CWT00008	A textbook chapter covering basic operation of reverse osmosis, electrodialysis, and evaporation. Specific information covered includes energy usage, design constraints, advantages, and disadvantages.	Publication; Copyrighted Material	Asano, Takashi	01/01/2007	Asano, T. 2007. Water Reuse: An Integrated Approach to Managing the World's Water Resources. Chap 9. Removal of Dissolved Constituents with Membranes.	Centralized Waste Treaters	64	No	Yes	CWT00008
1.3	EPA-HQ-OW-2015-0665-0535	Dewvaporation Desalination 5,000-Gallon-per-Day Pilot Plant - DCN CWT00009	A case study on a evaporation/distillation treatment technology for industrial wastewater treatment (10,000 to 45,000 mg/L TDS).	Publication; Other Governmental	Beckman, James	06/01/2008	Beckman, James. 2008. Dewvaporation Desalination 5,000-Gallon-per-Day Pilot Plant. U.S. Department of the Interior Bureau of Reclamation. (June).	Centralized Waste Treaters	87	No	No	CWT00009
1.3	EPA-HQ-OW-2015-0665-0541	Notes on Conference Call with Reserved Environmental Services, LLC, and Eastern Research Group, Inc. - DCN CWT00015	Notes taken on conference call between EPA, Reserved Environmental Services, LLC, and Eastern Research Group, Inc. The discussion included a description of Reserve's 100% recycling CWT plant for SGE operators.	Meeting/Teleconference Materials	ERG	02/01/2012	ERG. 2012. Notes on Conference Call with Reserved Environmental Services, LLC, and Eastern Research Group, Inc. (February 1).	Centralized Waste Treaters	8	No	No	CWT00015

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1.3	EPA-HQ-OW-2015-0665-0543	Unconventional E&P $8 Billion of US Water Services Market - DCN CWT00021	Online article on how water management issues in the U.S.'s exploration and production operation industry is resulting in $8 billion in spending for water services.	Publication	Environmental Leader	11/11/2013	Environmental Leader. 2013. Unconventional E&P $8 Billion of US Water Services Market. (November 11).	Centralized Waste Treaters	2	No	No	CWT00021
1.3	EPA-HQ-OW-2015-0665-0544	Study of the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources: Progress Report - DCN CWT00024	This report describes 18 research projects underway to answer key research questions and presents the progress made as of September 2012 for each of the projects.	Publication; USEPA	U.S. EPA	12/01/2012	U.S. EPA. 2012. Study of the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources: Progress Report. (December).	Centralized Waste Treaters	278	No	No	CWT00024
1.3	EPA-HQ-OW-2015-0665-0549	Notes on Conference Call with 212 Resources - DCN CWT00029	Notes taken on a conference call between EPA, 212 Resources, and Eastern Research Group, Inc. The discussion include details on 212 Resources evaporation technology.	Meeting/Teleconference Materials	ERG	01/09/2012	ERG. 2012. Notes on Conference Call with 212 Resources on 4 January 2012.	Centralized Waste Treaters	34	No	No	CWT00029

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1.3	EPA-HQ-OW-2015-0665-0551	Innovative Water Management Strategies for Future Marcellus Development - DCN CWT00033	This presentation discusses a new treatment technology, offered by Epiphany Solar Water Systems, that crystallizes produced water directly at shale gas well using concentrated solar technology.	Meeting/Teleconference Materials	Pettengill, Ron	01/01/2012	Pettengill, Ron. 2012. Innovative Water Management Strategies for Future Marcellus Development. Epiphany Solar Systems.	Centralized Waste Treaters	12	No	No	CWT00033
1.3	EPA-HQ-OW-2015-0665-0552	Water Infrastructure Versus Mobile Options for Treating and Disposing Fracking and Produced Water - DCN CWT00034	This presentation summarizes the services provided by High Sierra Energy, a wastewater treatment service provider for shale gas operators.	Meeting/Teleconference Materials	Themaat, Johan	10/29/2012	Themaat, Johan. 2012. Water Infrastructure Versus Mobile Options for Treating and Disposing Fracking and Produced Water. High Sierra Water Services.	Centralized Waste Treaters	35	No	No	CWT00034
1.3	EPA-HQ-OW-2015-0665-0553	Site Visit Report US Gas Field Fluids Management (formerly Clean Streams) Marcellus Shale Gas Operation - DCN CWT00035	This site visit report provides an overview of EPA's site visit to Clean Streams located in Williamsport, PA. Clean Streams operates a CWT that utilizes evaporation/condensation to treat Marcellus shale wastewater.	Report	U.S. EPA	05/22/2014	U.S. EPA. 2014. Site Visit Report US Gas Field Fluids Management (formerly Clean Streams) Marcellus Shale Gas Operation. (May 22).	Centralized Waste Treaters	15	No	No	CWT00035

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1.3	EPA-HQ-OW-2015-0665-0554	Site Visit Report Eureka Resources, LLC Marcellus Shale Gas Operations - DCN CWT00036	This site visit report summarizes information collected during EPA's site visit to Eureka Resources in Williamsport, PA. Eureka operates a CWT that utilizes evaporation/condensation to treat Marcellus wastewater and discharges to a local POTW.	Report	U.S. EPA	02/25/2012	U.S. EPA. 2012. Site Visit Report Eureka Resources, LLC Marcellus Shale Gas Operations. (February 25).	Centralized Waste Treaters	20	No	No	CWT00036
1.3	EPA-HQ-OW-2015-0665-0562	Site Visit Report Southwestern Energy Fayetteville Shale Operations - DCN CWT00046	A site visit report that summarizes Southwestern Energy's operations in the Fayetteville Shale play in Arkansas.	Report	U.S. EPA	03/30/2015	U.S. EPA. 2015. Site Visit Report Southwestern Energy Fayetteville Shale Operation (Sanitized).	Centralized Waste Treaters	34	No	No	CWT00046
1.3	EPA-HQ-OW-2015-0665-0596	Site Visit Report Seneca Resources Corporation - DCN CWT00054	Site visit report for Seneca Resources Corporation (Seneca Resources) and Heartland Technology Partners, LLC (Heartland Technology Partners).	Report	U.S. EPA	02/04/2015	U.S. EPA. 2015. Site Visit Report Seneca Resources Corporation, Covington, PA. (February 4).	Centralized Waste Treaters	19	No	No	CWT00054

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1.3	EPA-HQ-OW-2015-0665-0606	Iodide, Bromide, and Ammonium in Hydraulic Fracturing and Oil and Gas Wastewaters: Environmental Implications - DCN CWT00069	The paper demonstrates that OGW from Marcellus and Fayetteville hydraulic fracturing flowback fluids and Appalachian conventional produced waters is characterized by high chloride, bromide, iodide (up to 56 mg/L), and ammonium (up to 420 mg/L).	Publication; Copyrighted Material	Jennifer Harkness, et al.	12/19/2014	Jennifer Harkness, et al. 2014. Iodide, Bromide, and Ammonium in Hydraulic Fracturing and Oil and Gas Wastewaters: Environmental Implications.	Centralized Waste Treaters	9	No	Yes	CWT00069
1.3	EPA-HQ-OW-2015-0665-0607	Impacts of Shale Gas Wastewater Disposal on Water Quality in Western Pennsylvania - DCN CWT00077	The safe disposal of liquid wastes associated with oil and gas production in the US is a major challenge given their large volumes and typically high levels of contaminants. In PA, oil and gas wastewater is sometimes treated at brine treatment facilities.	Publication; Copyrighted Material	Nathaniel Warner et al.	09/10/2013	Nathaniel Warner et al. 2013. Impacts of Shale Gas Wastewater Disposal on Water Quality in Western Pennsylvania. Duke University. (September 10).	Centralized Waste Treaters	9	No	Yes	CWT00077
1.3	EPA-HQ-OW-2015-0665-0620	An Integrated Water Treatment Technology Solution for Sustainable Water Resource Management in the Marcellus Shale - DCN CWT00102	The goal of this research was to provide an integrated approach aimed at addressing the increasing water resource challenges between natural gas production and other water stakeholders in shale gas basins.	Report	Matthew Bruff	06/30/2011	Matthew Bruff. 2011. An Integrated Water Treatment Technology Solution for Sustainable Water Resource Management in the Marcellus Shale.	Centralized Waste Treaters	295	No	Yes	CWT00102

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1.3	EPA-HQ-OW-2015-0665-0621	The Economic Impact of the Value Chain of a Marcellus Shale Well - DCN CWT00103	The Economic Impact of the Value Chain of a Marcellus Shale Well Site examines the direct economic impact of a Marcellus Shale well located in Southwestern Pennsylvania. This study seeks to fill a critical information gap on the impact of gas drilling.	Economic Analysis	William E. Hefley	08/01/2011	William E. Hefley. 2011. The Economic Impact of the Value Chain of a Marcellus Shale Well. University of Pittsburgh. (August).	Centralized Waste Treaters	92	No	No	CWT00103
1.3	EPA-HQ-OW-2015-0665-0624	A Working Model for Oil and Gas Produced Water Treatment - DCN CWT00107	Presented at the Opportunities and Obstacles to Improving the Environmental Footprint of Energy Extraction in the Uintah Basin Workshop, October 14th 2010, Utah State University, Vernal, Utah.	Report	Shafer, Lee	10/14/2010	Lee Shafer. 2010. A Working Model for Oil and Gas Produced Water Treatment. Anticline Disposal LLC.	Centralized Waste Treaters	11	No	No	CWT00107
1.3	EPA-HQ-OW-2015-0665-0625	Water Recovery via Thermal Evaporative Processes For High Saline Frac Water Flowback - DCN CWT00108	To avoid the water related limitations and further the development of the nation's shale gas resources an economical process to recover and reuse water from hydrofracturing operations is required.	Study	Joseph Tinto, Robert Solomon	01/01/2010	Joseph Tinto, Robert Solomon. 2010. Water Recovery via Thermal Evaporative Processes For High Saline Frac Water Flowback. GE Water & Process Tech.	Centralized Waste Treaters	15	No	No	CWT00108

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1.3	EPA-HQ-OW-2015-0665-0626	Engineering firm ventures into wastewater, LNG - DCN CWT00110	Over the past few years, several companies have announced moves to convert their drilling rigs and frack trucks to be able to run on natural gas and large industrial manufacturers of such equipment are starting to offer new designs amenable to LNG.	Publication	Anya Litvak	12/02/2014	Anya Litvak. 2014. Engineering firm ventures into wastewater, LNG. Pittsburgh PostGazette.	Centralized Waste Treaters	10	No	No	CWT00110
1.3	EPA-HQ-OW-2015-0665-0628	Vendor profile: 212 Resources - DCN CWT00112	212 Resources (originally H2Oil Recovery Services) initially specialized in the reclamation of salable crude oil and fresh water from oil exploration and production tank bottoms, skim oil and produced water delivered for disposal.	Fact/Data Sheet	212 Resources	01/01/2011	212 Resources. 2011. Vendor profile: 212 Resources. ALL Consulting .	Centralized Waste Treaters	1	No	No	CWT00112
1.3	EPA-HQ-OW-2015-0665-0629	Vendor Profile: Ecosphere Technologies, Inc - DCN CWT00113	Ecosphere is a water engineering and services company that offers three water treatment options for shale gas producers: Ozonix EcosFrac™, a process that is used prior to fracturing to remove bacteria to help reduce scaling and corrosion	Fact/Data Sheet	Ecosphere Technologies Inc.	01/01/2011	Ecosphere Technologies Inc. 2011. Vendor Profile: Ecosphere Technologies, Inc. ALL Consulting .	Centralized Waste Treaters	2	No	No	CWT00113

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1.3	EPA-HQ-OW-2015-0665-0630	Determining the Minimum Treatment Levels Required for Production Efficiency: Stating the Lowest Acceptable Water Quality Levels for Effective Reuse in Fracs - DCN CWT00114	Technical presentation presented at 5th Annual Shale Play Water Management 2014 – Southern States Conference	Meeting or Teleconference Materials	Smith, Daniel	11/19/2014	Smith, Daniel. 2014. Determining the Minimum Treatment Levels Required for Production Efficiency. Apache.	Centralized Waste Treaters	20	No	No	CWT00114
1.3	EPA-HQ-OW-2015-0665-0565	Municipal Authority of the City of McKeesport Analysis of Gas Well Wastewaters as Required Under the PA DEP Administrative Order Dated October 23, 2008 (File 1) - DCN CWT00132	The analysis of gas well wastewaters performed by the Municipal Authority of the City of McKeesport as required under the PA DEP Administrative Order dated October 23, 2008.	Analysis	Rost, Joseph	08/12/2010	Rost, J. 2010. Municipal Authority of the City of McKeesport: Analysis of Gas Well Wastewaters as Required Under the PADEP Admin Order Dated 10/23/08.	Centralized Waste Treaters	28	No	No	CWT00132
1.3	EPA-HQ-OW-2015-0665-0566	Municipal Authority of the City of McKeesport Analysis of Gas Well Wastewaters as Required Under the PA DEP Administrative Order Dated October 23, 2008 (File 2) - DCN CWT00133	City of McKeesport analysis results of gas well wastewaters.	Analysis	Rost, Joseph	11/29/2010	Rost, J. 2010. Municipal Authority of the City of McKeesport: Analysis of Gas Well Wastewaters as Required Under the PA DEP AO Dated October 23, 2008.	Centralized Waste Treaters	32	No	No	CWT00133

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1.3	EPA-HQ-OW-2015-0665-0571	Underground Injection Wells for Produced Water Disposal - DCN CWT00146	A presentation on underground injection wells for produced water disposal.	Meeting or Teleconference Materials	McCurdy, Rick	03/29/2011	McCurdy, Rick. Underground Injection Wells for Produced Water Disposal. Chesapeake Energy Corp.	Centralized Waste Treaters	28	No	No	CWT00146
1.3	EPA-HQ-OW-2015-0665-0573	Produced Water in the Western United States: Geographical Distribution, Occurrence, and Composition - DCN CWT00149	Coproduced water is a byproduct of oil and natural gas production. Because it is in contact with hydrocarbon products and geologic formations in underground basins, it usually contains elevated concentrations of inorganic and organic constituents.	Publication; Other Governmental	Benko, K.L. and Drewes, J.E.	11/02/2008	Benko, K.L. and Drewes, J.E. 2008. Produced Water in the Western US: Geographical Distribution, Occurrence, and Composition. US Bureau of Reclamation.	Centralized Waste Treaters	8	No	No	CWT00149
1.3	EPA-HQ-OW-2015-0665-0582	An Integrated Framework for Treatment and Management of Produced Water - DCN CWT00188	A technical assessment of produced water treatment technologies and its management	Analysis	Colorado School of Mines (CSM)	11/01/2009	Colorado School of Mines (CSM). 2009. An Integrated Framework for Treatment and Management of Produced Water, 1st edition (November)	Centralized Waste Treaters	158	No	No	CWT00188

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1.3	EPA-HQ-OW-2015-0665-0584	Sequential Precipitation - Fractional Crystallization Treatment of Marcellus Shale Flowback and Production Wastewaters - DCN CWT00192	By 2016 development of the Marcellus shale gas play in the Northeast will generate an estimated60 million gallons per day of hydrofracture flowback and production wastewater.	Report	Timothy Keister, James Sleigh, and Megan B	01/01/2012	Keister, Timothy. 2012. Sequential Precipitation - Fractional Crystallization Treatment of Marcellus Shale Flowback and Production Wastewaters.	Centralized Waste Treaters	9	No	No	CWT00192
1.3	EPA-HQ-OW-2015-0665-0585	PURON® HOLLOW FIBER MODULES - DCN CWT00193	Vendor profile for the Puron hollow fiber modules from Koch Membrane Systems	Fact/Data Sheet	Koch Membrane Systems	01/01/2015	Koch Membrane Systems. 2015. Vendor Profile: PURON® HOLLOW FIBER MODULES.	Centralized Waste Treaters	1	No	No	CWT00193
1.3	EPA-HQ-OW-2015-0665-0586	Kubota Submerged Membrane Unit®. - DCN CWT00194	Vendor Profile for Kubota Submerged Membrane Unit® by KUBOTA Corporation. 2015.	Fact/Data Sheet	KUBOTA Corporation	01/01/2015	KUBOTA Corporation. 2015. Vendor Profile: Kubota Submerged Membrane Unit®.	Centralized Waste Treaters	6	No	No	CWT00194

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1.3	EPA-HQ-OW-2015-0665-0587	Performance evaluation of a submerged membrane bioreactor for the treatment of brackish oil and natural gas field produced water - DCN CWT00195	Produced water, which is co-produced during oil and gas manufacturing, represents one of the largest sources of oily wastewaters. Therefore, treatment of this produced water may improve the economic viability and lead to a new source of water for benefici	Analysis	Kose, Borte; et al	01/01/2012	Kose, Borte; et al. 2012. Performance evaluation of a submerged membrane bioreactor for the treatment of brackish oil and natural gas water	Centralized Waste Treaters	3	No	No	CWT00195
1.3	EPA-HQ-OW-2015-0665-0635	Biological Wastewater Treatment - DCN CWT00196	This article briefly discusses the differences between aerobic and anaerobic biological treatment processes and subsequently focuses on select aerobic biological treatment processes/technologies.	Publication; Copyrighted Material	Arun Mittal	01/01/2011	Mittal, Arun. 2011. Biological Wastewater Treatment. Water Today. Available online at: http://www.watertoday.org/Article%20Archieve/Aquatech%2012.pdf	Centralized Waste Treaters	8	No	No	CWT00196
1.3	EPA-HQ-OW-2015-0665-0636	Membrane Bioreator as an Advanced Wastewater Treatment Technology - DCN CWT00197	In this chapter, the authors have covered several aspects of MBR, with an exhaustiveoverview of its operational and biological performance.	Publication; Copyrighted Material	Radjenovic, Matosic, Mijatovic, Petrovic,	11/06/2007	Radjenovic, Matosic, Mijatovic, Petrovic, and Barcelo. 2008. Membrane Bioreator as an Advanced Wastewater Treatment Technology	Centralized Waste Treaters	66	No	No	CWT00197

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1.3	EPA-HQ-OW-2015-0665-0637	Membrane Bioreactors for Industrial Wastewater Treatment: Applicability and Selection of Optimal System Configuration - DCN CWT00199	This article explains the applicability and selection of most suitable system configurations for a membrane bioreactor	Publication; Copyrighted Material	Sutton, Paul M.	01/01/2006	Sutton, Paul M. 2006. Membrane Bioreactors for Industrial Wastewater Treatment: Applicability and Selection of Optimal System Configuration.	Centralized Waste Treaters	16	No	No	CWT00199
1.3	EPA-HQ-OW-2015-0665-0640	Considerations for development of Marcellus Shale gas - DCN CWT00209	An article on efforts of the operators working to optimize fracture patterns for improved production and to ensure containment and efficient use of frac fluids.	Report	J. Daniel Arthur, Brian Bohm and Mark Layn	01/01/2009	Arthur, Daniel J., Brian Bohm, and Mark Layne. 2009. Considerations for development of Marcellus Shale gas. World Oil. July 2009. ALL Consulting.	Centralized Waste Treaters	4	No	No	CWT00209
1.3	EPA-HQ-OW-2015-0665-0642	Unconventional Oil and Gas Production Drives Trends in Water Management and Treatment - DCN CWT00211	This article explores the outlook for the global market and gives insight into technology trends and the regions that hold the biggest opportunities for water treatment.	Report	Jelena Stanic	07/14/2014	Stanic, Jelena. Unconventional Oil and Gas Production Drives Trends in Water Management and Treatment. Oil and Gas Facilities	Centralized Waste Treaters	14	No	No	CWT00211

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1.3	EPA-HQ-OW-2015-0665-0643	Reasonable Foreseeable Development Scenario for Oil and Gas Buffalo Field Office Planning Area, Wyoming - DCN CWT00212	An analysis makes a base line projection that assumes future conventional oil and gas and coalbed natural gas related activity levels on all assessed lands within the Study Area	Report	Still, Dean P., Alfred M. Elser, and Fred	08/16/2012	Still, Dean P., et al. 2012. Reasonable Foreseeable Development Scenario for Oil and Gas Buffalo Field Office Planning Area, Wyoming	Centralized Waste Treaters	163	No	No	CWT00212
1.3	EPA-HQ-OW-2015-0665-0692	Frac Water Reuse Technologies DCN CWT00248	The development of technology to recycle and reuse this water is now becoming critical and Anguil Aqua has integrated solutions to help.	Press Release, Public Announcement/Notice	Anguil Aqua Systems	01/01/2016	Anguil Aqua Systems. 2016. Frac Water Reuse Technologies.	Centralized Waste Treaters	2	No	No	CWT00248
1.3	EPA-HQ-OW-2015-0665-0693	6th Annual Shale Plays Water Management Marcellus and Utica 2016 Conference Notes DCN CWT00249	Notes on the 6th Annual Shale Plays Water Management Marcellus and Utica 2016 Conference	Meeting Materials	ERG	01/01/2016	ERG. 2016. 6th Annual Shale Plays Water Management Marcellus and Utica 2016 Conference Notes.	Centralized Waste Treaters	38	No	No	CWT00249

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1.3	EPA-HQ-OW-2015-0665-0693.01	CONSOL Energy DCN CWT00249.A01	Presentation at the 6th Annual Shale Plays Water Management Marcellus and Utica 2016 Conference	Meeting Materials	Robert, Marshall	03/30/2016	Robert, Marshall. 2016. CONSOL Energy.	Centralized Waste Treaters	26	No	No	CWT00249.A01
1.3	EPA-HQ-OW-2015-0665-0693.02	How do we manage water use, reuse, recycling & disposal when we don't have any money? DCN CWT00249.A02	Presentation at the 6th Annual Shale Plays Water Management Marcellus and Utica 2016 Conference	Meeting Materials	Biehl, Eddy	03/30/2016	Biehl, Eddy. 2016. How do we manage water use, reuse, recycling & disposal when we don't have any money. Stonebridge Operating Co., LLC.	Centralized Waste Treaters	18	No	No	CWT00249.A02
1.3	EPA-HQ-OW-2015-0665-0693.03	Treatment of Produced Water to Discharge Quality: A North American Case Study DCN CWT00249.A03	Presentation at the 6th Annual Shale Plays Water Management Marcellus and Utica 2016 Conference	Meeting Materials	Nagghappan, L.	03/30/2016	Nagghappan, L. 2016. Treatment of Produced Water to Discharge Quality: A North American Case Study. Veolia.	Centralized Waste Treaters	14	No	No	CWT00249.A03

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1.3	EPA-HQ-OW-2015-0665-0693.04	The Water Exchange for the Energy Ecosystem DCN CWT00249.A04	Presentation at the 6th Annual Shale Plays Water Management Marcellus and Utica 2016 Conference	Meeting Materials	Adler, Josh	03/30/2016	Adler, Josh. 2016. The Water Exchange for the Energy Ecosystem. Sourcewater.	Centralized Waste Treaters	27	No	No	CWT00249.A04
1.3	EPA-HQ-OW-2015-0665-0693.05	Pennsylvania – Long Term Water Management: the need for long term water outlets DCN CWT00249.A05	Presentation at the 6th Annual Shale Plays Water Management Marcellus and Utica 2016 Conference	Meeting Materials	Anadarko Petroleum Corporation	03/30/2016	Anadarko Petroleum Corporation. 2016. Pennsylvania – Long Term Water Management: the need for long term water outlets.	Centralized Waste Treaters	26	No	No	CWT00249.A05
1.3	EPA-HQ-OW-2015-0665-0693.06	Mobile vs. Centralized Treatment DCN CWT00249.A06	Presentation at the 6th Annual Shale Plays Water Management Marcellus and Utica 2016 Conference	Meeting Materials	Patton, Mark	03/30/2016	Patton, Mark. 2016. Mobile vs. Centralized Treatment. Hydrozonix.	Centralized Waste Treaters	26	No	No	CWT00249.A06

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1.3	EPA-HQ-OW-2015-0665-0693.07	EVAPORATION CONSIDERATIONS: Significant Reduction of Evaporation for a Variety of Applications DCN CWT00249.A07	Presentation at the 6th Annual Shale Plays Water Management Marcellus and Utica 2016 Conference	Meeting Materials	Cameron, Ian	03/30/2016	Cameron, Ian. 2016. EVAPORATION CONSIDERATIONS: Significant Reduction of Evaporation for a Variety of Applications. Regen.	Centralized Waste Treaters	16	No	No	CWT00249.A07
1.3	EPA-HQ-OW-2015-0665-0693.08	EVAPORATION & CRYSTALLIZATION DCN CWT00249.A08	Presentation at the 6th Annual Shale Plays Water Management Marcellus and Utica 2016 Conference	Meeting Materials	Kalt, Brian	03/30/2016	Kalt, Brian. 2016. EVAPORATION & CRYSTALLIZATION. Fairmont Brine Processing.	Centralized Waste Treaters	3	No	No	CWT00249.A08
1.3	EPA-HQ-OW-2015-0665-0693.09	PA TENORM Study, Regulatory Framework & Waste Management DCN CWT00249.A09	Presentation at the 6th Annual Shale Plays Water Management Marcellus and Utica 2016 Conference. Presented by Jason Hubler.	Meeting Materials	Allard, Dave and Lombard, Andy	03/31/2016	Allard, Dave and Lombard, Andy. 2016. PA TENORM Study, Regulatory Framework & Waste Management. PA DEP.	Centralized Waste Treaters	62	No	No	CWT00249.A09

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1.3	EPA-HQ-OW-2015-0665-0693.10	Reusing Marcellus Water in Utica Wells DCN CWT00249.A10	Presentation at the 6th Annual Shale Plays Water Management Marcellus and Utica 2016 Conference	Meeting Materials	Tucker, Yael	03/30/2016	Tucker, Yael. 2016. Reusing Marcellus Water in Utica Wells. DOE. NETL.	Centralized Waste Treaters	18	No	No	CWT00249.A10
1.3	EPA-HQ-OW-2015-0665-0693.11	Appalachian Shale Energy Produced Fluids Management and UIC Well Disposal Trends DCN CWT00249.A11	Presentation at the 6th Annual Shale Plays Water Management Marcellus and Utica 2016 Conference	Meeting Materials	Yoxtheimer, David	03/30/2016	Yoxtheimer, David. 2016. Appalachian Shale Energy Produced Fluids Management and UIC Well Disposal Trends. Penn State University.	Centralized Waste Treaters	20	No	No	CWT00249.A11
1.3	EPA-HQ-OW-2015-0665-0693.12	Summary of Day #1 DCN CWT00249.A12	Presentation at the 6th Annual Shale Plays Water Management Marcellus and Utica 2016 Conference	Meeting Materials	Cameron, Ian	03/31/2016	Cameron, Ian. 2016. Summary of Day #1. 6th Annual Shale Plays Water Management Marcellus and Utica 2016 Conference.	Centralized Waste Treaters	6	No	No	CWT00249.A12

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1.3	EPA-HQ-OW-2015-0665-0693.13	Mitigating Injection-Induced Seismicity DCN CWT00249.A13	Presentation at the 6th Annual Shale Plays Water Management Marcellus and Utica 2016 Conference	Meeting Materials	Bates, William	03/28/2016	Bates, William. 2016. Mitigating Injection-Induced Seismicity. US EPA. OGWDW.	Centralized Waste Treaters	34	No	No	CWT00249.A13
1.3	EPA-HQ-OW-2015-0665-0693.14	How Injection Wells Are Being Cost-Effectively Constructed, Implemented And Operated Within State Regulations And Ensuring Seismic Events Are Mitigated DCN CWT00249.A14	Presentation at the 6th Annual Shale Plays Water Management Marcellus and Utica 2016 Conference	Meeting Materials	Cameron, Ian	03/31/2016	Cameron, Ian. 2016. How Injection Wells Are Being Cost-Effectively Constructed & Operated w/in State Regs & Ensuring Seismic Events Are Mitigated.	Centralized Waste Treaters	2	No	No	CWT00249.A14
1.3	EPA-HQ-OW-2015-0665-0693.15	WATER MANAGEMENT: HOLISTIC APPROACH DCN CWT00249.A15	Presentation at the 6th Annual Shale Plays Water Management Marcellus and Utica 2016 Conference	Meeting Materials	Fernley, Amanda	03/31/2016	Fernley, Amanda. 2016. WATER MANAGEMENT: HOLISTIC APPROACH. Antero Resources.	Centralized Waste Treaters	7	No	No	CWT00249.A15

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1.3	EPA-HQ-OW-2015-0665-0693.16	Hearing Updates From Regulatory Bodies For Marcellus And Utica On How Regulations Will Affect The Use Of Surface Water For Disposal And Water Sourcing DCN CWT00249.A16	Presentation at the 6th Annual Shale Plays Water Management Marcellus and Utica 2016 Conference	Meeting Materials	Dehoff, Andrew	03/31/2016	Dehoff, A. 2016. Hearing Updates From Reg Bodies For Marcellus & Utica On How Regs Will Affect The Use Of Surface Water For Disposal & Water Sourcing.	Centralized Waste Treaters	16	No	No	CWT00249.A16
1.3	EPA-HQ-OW-2015-0665-0693.17	Brine Transfer Line Integrity: Temporary & permanent line installation & testing alternatives DCN CWT00249.A17	Presentation at the 6th Annual Shale Plays Water Management Marcellus and Utica 2016 Conference	Meeting Materials	Biehl, Eddy	03/31/2016	Biehl, Eddy. 2016. Brine Transfer Line Integrity: Temporary & permanent line installation & testing alternatives. Stonebridge Operating Co., LLC.	Centralized Waste Treaters	23	No	No	CWT00249.A17
1.3	EPA-HQ-OW-2015-0665-0695	Pretreatment regulated CWT facilities in Arkansas from the Arkansas Department of Environmental Quality DCN CWT00254	ADEQ list of pretreatment regulated CWT facilities found online at: http://www2.adeq.state.ar.us/water/branch_permits/individual_permits/pretreatment/industrial_users.aspx#Search	Fact/Data Sheet	Arkansas DEQ	01/01/2014	Arkansas DEQ. 2014. Pretreatment regulated CWT facilities in Arkansas from the Arkansas Department of Environmental Quality.	Centralized Waste Treaters	4	No	No	CWT00254

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1.3	EPA-HQ-OW-2015-0665-0706	MPDES Individual Permits DCN CWT00258	An MPDES General Permit is a pre-existing permit for wastewater discharges associated with common activities, such as concentrated animal feeding operations and storm water discharges from construction or industrial activity.	Fact/Data Sheet	Montana DEQ	03/16/2017	Montana DEQ. 207. MPDES Individual Permits. Available online at:http://deq.mt.gov/Water/WPB/mpdes/majorpermits	Centralized Waste Treaters	19	No	No	CWT00258
1.3	EPA-HQ-OW-2015-0665-0709	Enforcement and Compliance History Online DCN CWT00262	Use EPA's Enforcement and Compliance History Online website to search for facilities in your community to assess their compliance with environmental regulations.	Fact/Data Sheet	U.S. EPA	01/01/2017	U.S. EPA. 2017. Enforcement and Compliance History Online. https://echo.epa.gov/	Centralized Waste Treaters	2	No	No	CWT00262
1.3	EPA-HQ-OW-2015-0665-0966	Envirofacts Database DCN CWT00263	Retrieve information from multiple sources of Envirofacts' System Data for your area of interest.	Fact/Data Sheet	U.S. EPA	01/01/2017	U.S. EPA. 2017. Envirofacts Database. https://www3.epa.gov/enviro/	Centralized Waste Treaters	3	No	No	CWT00263

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1.3	EPA-HQ-OW-2015-0665-0732	The Water-Energy Nexus: Challenges and Opportunities DCN CWT00294	This nexus report frames an integrated challenge and opportunity space around the water-energy nexus.	Publication; Other Governmental	U.S. DOE	06/01/2014	United States Department of Energy (U.S. DOE). 2014. The Water-Energy Nexus: Challenges and Opportunities.	Centralized Waste Treaters	258	No	No	CWT00294
1.3	EPA-HQ-OW-2015-0665-1112	Analysis of Hydraulic Fracturing Fluid Data from the FracFocus Chemical Disclosure Registry 1.0 - DCN CWT00328	Report evaluating hydraulic fracturing fluid data reported in the FracFocus Registry. Includes discussion of methodology for extracting and analyzing the data and presents results of data on base fluids, proppants, and chemicals.	Publication; USEPA	U.S. EPA	03/01/2015	U.S. EPA. 2015. Analysis of Hydraulic Fracturing Fluid Data from the FracFocus Chemical Disclosure Registry 1.0. (March).	Centralized Waste Treaters	168	No	No	CWT00328
1.3	EPA-HQ-OW-2015-0665-1113	Hydraulic Fracturing Fluid DCN CWT00329	List of fracking chemicals	Publication; Copyrighted Material	Exxon Mobil Corporation	01/01/2014	ExxonMobil Corporation. 2014. Hydraulic Fracturing Fluid. XTO Energy. Downloaded on 6/13/2014.	Centralized Waste Treaters	4	No	Yes	CWT00329

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1.3	EPA-HQ-OW-2015-0665-1065	An Investigation of Naturally Occurring Radioactive Materials (NORM) in Oil and Gas Wells in New York State. NYSDEC DCN CWT00949	Investigation report of naturally occurring radioactive materials (NORM) in oil and gas wells in New York State. Report includes background and procedures for selecting sampling and survey locations, a presentation and analysis of results, and discussion.	Report	NYSDEC	04/01/1999	NYSDEC. 1999. An Investigation of Naturally Occurring Radioactive Materials (NORM) in Oil and Gas Wells in New York State. DEC Publication.	Centralized Waste Treaters	86	No	No	CWT00333
1.3	EPA-HQ-OW-2015-0665-1066	Composition and Properties of Drilling and Completion Fluids. 6th edition DCN CWT00334	Composition and Properties of Drilling and Completion Fluids, Sixth Edition.	Publication; Copyrighted Material	Caen, R., Darley, H.C.H., and G. R. Gray.	01/01/2011	Caen, R., Darley, et al. 2011. Composition and Properties of Drilling and Completion Fluids. 6th edition. Gulf Professional Publishing: Waltham, MA.	Centralized Waste Treaters	696	No	Yes	CWT00334
1.3	EPA-HQ-OW-2015-0665-1067	Evaluation of Potential Impacts of Hydraulic Fracturing Flowback Fluid Additives on Microbial Processes in Publicly-Owned Treatment Works (POTWs) DCN CWT00335	This document analyzes the potential effects of discharging Marcellus flowback to a POTW.	Report	Gradient	12/31/2009	Gradient. 2009. Evaluation of Potential Impacts of Hydraulic Fracturing Flowback Fluid Additives on Microbial Processes in POTWs	Centralized Waste Treaters	12	No	No	CWT00335

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1.3	EPA-HQ-OW-2015-0665-0977	Uinta Water Management DCN CWT00341	PowerPoint presentation from Water Management for Shale Plays Conference (May 2014) about Uinta water management practices.	Meeting or Teleconference Materials	Johnson, Tommy and Harry, David	05/28/2014	Johnson, Tommy and Harry, David. 2014. Uinta Water Management. Water Management for Shale Plays Conference. (May 28).	Centralized Waste Treaters	28	No	No	CWT00341
1.3	EPA-HQ-OW-2015-0665-0978	Key Considerations for Frac Flowback / Produced Water Reuse and Treatment DCN CWT00342	This presentation provides TDS concentrations for various shale plays around the country.	Meeting or Teleconference Materials	Kimball, Robert	05/01/2012	Robert Kimball. 2012. Key Considerations for Frac Flowback / Produced Water Reuse and Treatment. CDM Smith.	Centralized Waste Treaters	44	No	No	CWT00342
1.3	EPA-HQ-OW-2015-0665-0981	Produced Water Reuse and Recycling Challenges and Opportunities Across Major Shale Plays DCN CWT00345	A presentation on produced water reuse and recycling challenges and opportunities across major shale plays.	Meeting or Teleconference Materials	Mantell, Matthew	03/29/2011	Mantell, Matthew, Chesapeake Energy Corp. 2011. Produced Water Reuse and Recycling Challenges and Opportunities Across Major Shale Plays	Centralized Waste Treaters	40	No	No	CWT00345

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1.3	EPA-HQ-OW-2015-0665-0591	Bakken Water Opportunities Assessment - Phase 1 - DCN CWT00356	This report describes wastewater volumes, wastewater characteristics, and wastewater management in the Bakken shale play.	Letter	Stepan, Daniel et al.	04/01/2010	Stepan, D.J., et. al. 2010. Bakken Water Opportunities Assessment - Phase 1. Energy & Env Research Cntr, Univ of ND. Prepared for Nat'l Energy Tech Lab	Centralized Waste Treaters	57	No	No	CWT00356
1.3	EPA-HQ-OW-2015-0665-0592	Mid-Continent Water Management for Stimulation Operations - DCN CWT00357	A presentation on mid-continent water management for stimulation operations.	Press Release, Public Announcement/Notice	Tipton, Steven	03/30/2011	Tipton, Steven, Newfield Exploration. 2011. Mid-Continent Water Management for Stimulation Operations	Centralized Waste Treaters	25	No	No	CWT00357
1.3	EPA-HQ-OW-2015-0665-0650	Contaminant Characterization of Effluent from PA Brine Treatment Josephine Facility DCN CWT00359	A study on the contaminant characterization of effluent from PA Brine Treatment Inc., Josephine Facility that is being released into Blacklick Creek in Indiana County, PA.	Report	Volz, Conrad; Ferrar, Kyle; Michanowicz, D	03/25/2011	Volz, Conrad; Ferrar, Kyle; Michanowicz, Drew et. al. 2011. Contaminant Characterization of Effluent from PA Brine Treatment Josephine Facility	Centralized Waste Treaters	118	No	No	CWT00359

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1.3	EPA-HQ-OW-2015-0665-0656	Water Quality Literature Review and Field Monitoring of Active Shale Gas Wells. Phase I: Assessing Environmental Impacts of Horizontal Gas Well Drilling Operations DCN CWT0365	WV DEP Final Report on the water quality literature review and field monitoring of active shale gas wells. Includes results of the literature review, water and waste stream monitoring including the plan, data analysis, and results.	Report	Ziemkiewicz, Paul	02/15/2013	Ziemkiewicz, P. 2013. Water Quality Literature Review and Field Monitoring of Active Shale Gas Wells. (February 15).	Centralized Waste Treaters	141	No	No	CWT00365
1.4	EPA-HQ-OW-2015-0665-0689	Public Comment EPA-HQ-OW-2014-0598-0969: Letter to Lisa Biddle DCN CWT00245	A letter to Lisa Biddle through the public submission of comments on the Proposed ELG Rulemaking.	Letter	Meyer, Stanley	07/16/2015	Meyer, Stanley. 2015. Public Comment EPA-HQ-OW-2014-0598-0969: Letter to Lisa Biddle. JS Meyer Engineering.	Centralized Waste Treaters	2	No	No	CWT00245
1.4	EPA-HQ-OW-2015-0665-0689.1	Public Comment EPA-HQ-OW-2014-0598-0969: Oil and Gas Frack, Produced Flowback Water Processing Technology DCN CWT00245.A01	Technology presentation submitted through public comments on the Proposed ELG Rulemaking.	Fact/Data Sheet	JS Meyer Engineering	07/21/2015	JS Meyer Engineering. 2015. Public Comment EPA-HQ-OW-2014-0598-0969: Oil and Gas Frack, Produced Flowback Water Processing Technology.	Centralized Waste Treaters	23	No	No	CWT00245.A1

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1.4	EPA-HQ-OW-2015-0665-0738	Anticline Disposal DCN CWT00276	A summary of Anticline Disposal.	Publication; Copyrighted Material	Sublette Examiner	09/25/2003	Sublette Examiner. 2003. Anticline Disposal. Volume 3, Number 26. http://www.sublette.com/examiner/v3n26/v3n26s5.htm.	Centralized Waste Treaters	2	No	Yes	CWT00276
1.4	EPA-HQ-OW-2015-0665-0739	List of Waste Disposal Costs DCN CWT00277	Website for the PennWell Corporation with lists of waste disposal costs; accessed in June-July 2014.	Fact/Data Sheet	PennWell	06/01/2014	PennWell. 2014. List of Waste Disposal Costs.	Centralized Waste Treaters	2	No	No	CWT00277
1.4	EPA-HQ-OW-2015-0665-0740	Facility Detail: Dishon Disposal, Inc. DCN CWT00278	Website for CHWMG, Inc. with facility details for Dishon Disposal, Inc; accessed in June-July 2014.	Publication; Copyrighted Material	CHWMEG, Inc.	05/11/2017	CHWMEG, Inc. 2017. Facility Detail: Dishon Disposal, Inc. http://www.chwmeg.org/asp/search/detail.asp?ID=10357.	Centralized Waste Treaters	2	No	Yes	CWT00278

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1.4	EPA-HQ-OW-2015-0665-0741	Administrative Order for Compliance on Consent EPA Docket No.: CWA-03-2013-0051DN DCN CWT00279	Administrative Order for Compliance on ConsentEPA Docket No.: CWA-03-2013-0051DN	Order	U.S. EPA Region 3	05/08/2013	U.S. EPA Region 3. 2013. Administrative Order for Compliance on Consent EPA Docket No.: CWA-03-2013-0051DN.	Centralized Waste Treaters	14	No	No	CWT00279
1.4	EPA-HQ-OW-2015-0665-0716	Desalination of Oilfield-Produced Water at the San Ardo Water Reclamation Facility, CA DCN CWT00280	Paper discussing the successful application of reverse osmosis membranes.	Publication; Copyrighted Material	Webb, Charles	03/24/2009	Webb, Charles. 2009. Desalination of Oilfield-Produced Water at the San Ardo Water Reclamation Facility, CA. Society of Petroleum Engineers.SPE121520.	Centralized Waste Treaters	21	No	Yes	CWT00280
1.4	EPA-HQ-OW-2015-0665-0717	Envirofacts DCN CWT00281	Retrieve information from multiple sources of Envirofacts' System Data for your area of interest.	Publication; USEPA	U.S. EPA	05/11/2017	U.S. EPA. 2017. Envirofacts. https://www3.epa.gov/enviro/.	Centralized Waste Treaters	2	No	No	CWT00281

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1.4	EPA-HQ-OW-2015-0665-0718	Desalinating Produced Water for Beneficial Reuse DCN CWT00282	http://www.waterworld.com/articles/iww/print/volume-11/issue-2/feature-editorial/desalinating-produced-water-for-beneficial-re-use.html	Press Release, Public Announcement/Notice	Lnsp Nagghappan	05/11/2017	Lnsp Nagghappan. 2017. Desalinating Produced Water for Beneficial Reuse. Industrial WaterWorld.	Centralized Waste Treaters	5	No	No	CWT00282
1.4	EPA-HQ-OW-2015-0665-0719	Williams Fork, Piceance Basin: Flowback Water Reuse – Quality and Quantity DCN CWT00283	http://www2.epa.gov/sites/production/files/documents/piceance_reuse.pdf	Fact/Data Sheet	Jill E. Cooper	03/30/2011	Jill E. Cooper. 2011. Williams Fork, Piceance Basin: Flowback Water Reuse – Quality and Quantity. Encana Oil & Gas (USA) Inc.	Centralized Waste Treaters	17	No	No	CWT00283
1.4	EPA-HQ-OW-2015-0665-0720	New digs: Halliburton officially opens expanded Fort Lupton facility DCN CWT00284	http://www.ftluptonpress.com/content/new-digs-halliburton-officially-opens-expanded-fort-lupton-facility	Press Release, Public Announcement/Notice	Gene Sears	05/29/2013	Gene Sears. 2013. New digs: Halliburton officially opens expanded Fort Lupton facility. Fort Lupton Press.	Centralized Waste Treaters	1	No	No	CWT00284

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1.4	EPA-HQ-OW-2015-0665-0721	Waste Management Plan DCN CWT00285	http://www.adeq.state.ar.us/ftproot/Pub/WebDatabases/PermitsOnline/NPDES/PermitInformation/5139-W_Waste%20Management%20and%20Closure%20Plans_20111214.pdf	Fact/Data Sheet	Southwestern Energy, Inc.	09/01/2011	Southwestern Energy, Inc. 2011. Waste Management Plan.	Centralized Waste Treaters	38	No	No	CWT00285
1.4	EPA-HQ-OW-2015-0665-0725	AR0052175 Public Notice of Draft Permit DCN CWT00286	http://www.adeq.state.ar.us/ftproot/Pub/WebDatabases/PermitsOnline/NPDES/PermitInformation/AR0052175_PN%20of%20Draft%20to%20Petit%20Jean%20Country%20Headlight_20121220.pdf	E-mail	Scott Waller	12/20/2012	Scott Waller. 2012. AR0052175 Public Notice of Draft Permit. Arkansas Department of Environmental Quality.	Centralized Waste Treaters	3	No	No	CWT00286
1.4	EPA-HQ-OW-2015-0665-0726	First-Of-Its-Kind Desalination Plant Unveiled In Texas DCN CWT00287	http://www.wateronline.com/doc/first-of-its-kind-desalination-plant-unveiled-in-texas-0001	Press Release, Public Announcement/Notice	Sara Jerome	06/30/2014	Sara Jerome. 2014. First-Of-Its-Kind Desalination Plant Unveiled In Texas. Water Online.	Centralized Waste Treaters	1	No	No	CWT00287

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1.4	EPA-HQ-OW-2015-0665-0730	Oil and gas player commissions produced water treatment plant DCN CWT00292	http://www.desalination.biz/news/news_story.asp?id=8025	Press Release, Public Announcement/Notice	Water, Desalination, and Reuse	05/12/2015	Water, Desalination, and Reuse. 2015. Oil and gas player commissions produced water treatment plant.	Centralized Waste Treaters	1	No	No	CWT00292
1.4	EPA-HQ-OW-2015-0665-1028	Game Changing Technology for Treating and Recycling Frac Water - DCN CWT00313	This paper addresses an advanced oxidation and precipitation water treatment process employed as an on-the-fly fluid pretreatment during hydraulic fracturing operations.	Report	Ely, John W.; Horn, Aaron; Cathey, Robbie;	10/30/2011	Ely, John W., et al. 2011. Game Changing Technology for Treating and Recycling Frac Water. Society of Petroleum Engineering. SP SPE-214545-PP	Centralized Waste Treaters	12	No	Yes	CWT00313
1.4	EPA-HQ-OW-2015-0665-0969	GPRI Reverse Osmosis Research - DCN CWT00314	A teleconference call with a researcher from Global Petroleum Research Institute discussing reverse osmosis as a wastewater treatment technology for shale gas operators.	Meeting or Teleconference Materials	Burnett, David	09/26/2011	Burnett, D. 2011. Telephone Communication with David Burnett, Global Petroleum Research Institute, and Sarah Hays, Eastern Research Group, Inc.	Centralized Waste Treaters	2	No	No	CWT00314

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1.4	EPA-HQ-OW-2015-0665-1031	A Guide to Practical Management of Produced Water from Onshore Oil and Gas Operations in the United States (DE-PS26-04NT15460-02) DCN CWT00690	A report that focuses on technologies and practices used to manage UOG wastewater.	Report	ALL Consulting	10/01/2006	ALL Consulting, LLC. 2006. A Guide to Practical Management of Produced Water from Onshore Oil and Gas Operations in the United States	Centralized Waste Treaters	316	No	No	CWT00318
1.4	EPA-HQ-OW-2015-0665-1032	Minimum Effective Dose: A Study of Flowback and Produced Fluid Treatment for Use as Hydraulic Fracturing Fluid - DCN CWT00319	This paper was prepared for presentation at the American Association of Petroleum Geologists "Geosciences Technology Workshop" in San Antonio, TX,	Publication; Copyrighted Material	Horn, Aaron	03/18/2013	Horn, A; Patton, M; Hu, J. 2013. Minimum Effective Dose: A Study of Flowback and Produced Fluid Treatment for Use as Hydraulic Fracturing Fluid.	Centralized Waste Treaters	7	No	Yes	CWT00320
1.4	EPA-HQ-OW-2015-0665-1061	Development Document for Effluent Limitation Guidelines and Standards for the Centralized Waste Treatment Industry - Final (EPA 821-R-00-020) - DCN CWT00324	A development document for the CWT point source category including subcategories A (metal bearing wastewater), B (oily wastewater), C (organic waste), and D (combination of A, B, and C).	Publication; USEPA	U.S. EPA	08/01/2000	U.S. EPA. 2000. Development Document for Effluent Limitation Guidelines and Standards for the Centralized Waste Treatment Industry EPA 821-R-00-020.	Centralized Waste Treaters	1	No	No	CWT00324

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1.4	EPA-HQ-OW-2015-0665-1116	An Integrated Water Treatment Technology Solution for Sustainable Water Resource Management in the Marcellus Shale - DCN CWT00325	A report investigating sustainable solutions for wastewater from the Marcellus Shale. A life cycle analysis is presented on the AltelaRain 4000 evaporation system.	Publication; Other Governmental	Bruff, Matthew	06/30/2011	Bruff, Matthew. 2011. An Integrated Water Treatment Technology Solution for Sustainable Water Resource Management in the Marcellus Shale.	Centralized Waste Treaters	295	No	No	CWT00325
1.4	EPA-HQ-OW-2015-0665-1064	The Economics of Water Management - DCN CWT00332	This presentation provides an overview of Pioneer Natural Resource's wastewater management in the Eagle Ford formation.	Meeting or Teleconference Materials	Dunkel, Michael	11/28/2012	Michael Dunkel. 2012. The Economics of Water Management. Pioneer Natural Resources.	Centralized Waste Treaters	15	No	No	CWT00332
1.4	EPA-HQ-OW-2015-0665-0975	Characterization of Marcellus Shale and Barnett Shale Flowback Waters and Technology Development for Water Reuse DCN CWT00339	A presentation on characterization of Marcellus and Barnett Shale flowback waters and technology development for water reuse.	Meeting or Teleconference Materials	Hayes, Tom	03/30/2011	Hayes, T. 2011. Characterization of Marcellus Shale and Barnett Shale Flowback Waters and Technology Development for Water Reuse	Centralized Waste Treaters	48	No	No	CWT00339

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1.4	EPA-HQ-OW-2015-0665-0976	Recovering Valuable Byproducts from Oil and Gas Wastes DCN CWT00340	Paper on drilling fluid wastewater treatment and management.	Study	Huffmyer, Russell; Gehucheten, John	11/16/2013	Huffmyer, Russell and Gehucheten, John. 2013. Recovering Valuable Byproducts from Oil and Gas Wastes. HDR Engineering, Inc. IWC-13-37. (November 17).	Centralized Waste Treaters	13	No	No	CWT00340
1.4	EPA-HQ-OW-2015-0665-0984	Examining Water Production Volumes and Produced Water Quality in the Mississippi Lime to Develop Appropriate Management Strategies - DCN CWT00348	Examining Water Production Volumes and Produced Water Quality in the Mississippi Lime to Develop Appropriate Management Strategies presentation	Meeting or Teleconference Materials	Murray, Kyle E.	06/01/2013	Murray, K.E. 2013. Examining Water Production Volumes and Produced Water Quality in the Mississippi Lime to Develop Appropriate Management Strategies.	Centralized Waste Treaters	11	No	No	CWT00348
1.4	EPA-HQ-OW-2015-0665-0588	Optimizing Fracturing Fluids from Flowback Water DCN CWT00353	An article about the design and procedures of reusing flowback and produced water as hydraulic fracturing fluids.	Publication; Copyrighted Material	Rimassa, Shawn; Howard, Paul; Blow, Kriste	06/01/2009	Rimassa, Shawn; Howard, Paul; Blow, Kristel; Schlumberger. 2009. Optimizing Fracturing Fluids from Flowback Water. Society of Petroleum Engineers.	Centralized Waste Treaters	9	No	Yes	CWT00353

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1.4	EPA-HQ-OW-2015-0665-0589	Pretreatment Targets for Salt Recovery from Marcellus Shale Gas Produced Water DCN CWT00354	Paper on produced water treatment using chemical addition.	Study	Silva, James	11/16/2013	Silva, J; Gettings, R; Kostedt, W; Watkins, V. 2013. Pretreatment Targets for Salt Recovery from Marcellus Shale Gas Produced Water.	Centralized Waste Treaters	10	No	No	CWT00354
1.4	EPA-HQ-OW-2015-0665-0590	Key Shale Gas Water Management Strategies: An Economic Assessment Tool - DCN CWT00355	Paper analyzing the total life cycle water management costs per frac comparing options and costs of water supply and water transportation; cost and options for disposal, re-use, and recycling; and impact of water quality on frac chemical costs	Publication; Copyrighted Material	Slutz, James et al.	09/11/2013	Slutz, J; Anderson, J; Broderick, R; Horner, P. 2012. Key Shale Gas Water Management Strategies: An Economic Assessment Tool. (September 11).	Centralized Waste Treaters	15	No	Yes	CWT00355
1.4	EPA-HQ-OW-2015-0665-0655	Flowback Treatment and Reuse Strategies for Tight Oil Formations DCN CWT00364	This presentation examines treatment and reuse strategies for various tight oil formations.	Meeting or Teleconference Materials	Yoxtheimer, Dave	10/29/2012	Yoxtheimer, Dave. 2012. Flowback Treatment and Reuse Strategies for Tight Oil Formations. Penn State Marcellus Center for Outreach and Research.	Centralized Waste Treaters	20	No	No	CWT00364

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1.5	EPA-HQ-OW-2015-0665-0608	Offsite Commercial Disposal of Oil and Gas Exploration and Production Waste: Availability, Options, and Costs - DCN CWT00084	This report describes the new 2005–2006 database and focuses on the availability of offsite commercial disposal companies, the prevailing disposal methods, and estimated disposal costs.	Publication; Other Governmental	Veil, J.A. and Puder, M.G.	08/01/2006	Veil, J.A. & Puder, M.G. 2006. Offsite Commercial Disposal of O&G E&P Waste: Availability, Options, and Costs. Argonne National Laboratory.	Centralized Waste Treaters	148	No	No	CWT00084
1.5	EPA-HQ-OW-2015-0665-0609	List of Centralized Waste Treatment Facilities for Promulgation - DCN CWT00086	This file contains non confidential information related to a list of CWTs.	Fact/Data Sheet	U.S. EPA	02/16/2000	U.S. EPA. 2000. List of Centralized Waste Treatment Facilities for Promulgation.	Centralized Waste Treaters	11	No	No	CWT00086
1.5	EPA-HQ-OW-2015-0665-0675	Analysis of Centralized Waste Treatment Facilities (CWTs) Accepting UOG Wastewater DCN CWT00087	Memorandum summarizing information available for UOG extraction wastewater management at CWT facilities	Memorandum	ERG	06/01/2016	ERG. 2016. Analysis of Centralized Waste Treatment Facilities (CWTs) Accepting UOG Extraction Wastewater.	Centralized Waste Treaters	14	No	No	CWT00087

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1.5	EPA-HQ-OW-2015-0665-0675.1	Analysis of Centralized Waste Treatment Facilities (CWTs) Accepting UOG Wastewater Attachment 1: UOG CWT List and Analysis DCN CWT00087.A01	Tables and graphs which show the number of new wells drilled per year and the number of active CWTs in the Marcellus and Utica regions from 2004 through 2012	Data	ERG	06/01/2016	ERG. 2016. Analysis of Centralized Waste Treatment Facilities (CWTs) Accepting UOG Wastewater Attachment 1: UOG CWT List and Analysis	Centralized Waste Treaters	1	No	No	CWT00087.A1
1.5	EPA-HQ-OW-2015-0665-0610	Centralized Waste Treatment Facilities in New York - DCN CWT00088	A list of CWT Facilities in New York.	Fact/Data Sheet	New York DEC		New York DEC. Unknown. Centralized Waste Treatment Facilities in New York.	Centralized Waste Treaters	2	No	No	CWT00088
1.5	EPA-HQ-OW-2015-0665-0611	Facility Chief's Order Summaries from Ohio - DCN CWT00089	A table of chief order summaries from Ohio.	Data	Ohio DNR	03/06/2014	Ohio DNR. 2014. Facility Chief's Order Summaries from Ohio.	Centralized Waste Treaters	2	No	No	CWT00089

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1.5	EPA-HQ-OW-2015-0665-0612	Ohio Department of Natural Resources Permitted Facilities - DCN CWT00090	A list of 23 ODNR permitted facilities.	Fact/Data Sheet	Ohio DNR		Ohio DNR. Unknown. Ohio Department of Natural Resources Permitted Facilities.	Centralized Waste Treaters	6	No	No	CWT00090
1.5	EPA-HQ-OW-2015-0665-0613	Oil and Gas Wastewater Facility List - DCN CWT00091	A listing of oil and gas wastewater facilities in Pennsylvania.	Fact/Data Sheet	Pennsylvania Department of Environmental P		PA DEP. Unknown. Oil and Gas Wastewater Facility List. https://www.paoilandgasreporting.state.pa.us/publicreports/Modules.	Centralized Waste Treaters	3	No	No	CWT00091
1.5	EPA-HQ-OW-2015-0665-0614	Commercial Recycling & Surface Disposal Facilities - DCN CWT00092	A list of commercial recycling & surface disposal facilities in Texas.	Fact/Data Sheet	Railroad Commission of Texas	05/29/2014	Railroad Commission of Texas. 2014. Commercial Recycling & Surface Disposal Facilities.	Centralized Waste Treaters	24	No	No	CWT00092

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1.5	EPA-HQ-OW-2015-0665-0615	Commercial E&P Waste Disposal Facilities in the United States - DCN CWT00093	A list of commercial exploration and production waste disposal facilities in the United States.	Data	Veil, J.A.	01/01/2014	Veil, J.A. 2014. Commercial E&P Waste Disposal Facilities in the United States.	Centralized Waste Treaters	1	No	No	CWT00093
1.5	EPA-HQ-OW-2015-0665-0616	Neptune Water Treatment Facility - DCN CWT00094	A factsheet presenting the development of the Neptune Water Treatment Facility in Wyoming.	Fact/Data Sheet	Encana		Encana. Unknown. Neptune Water Treatment Facility.	Centralized Waste Treaters	2	No	No	CWT00094
1.5	EPA-HQ-OW-2015-0665-0617	Permitted Commercial Oil Disposal Facilities - DCN CWT00095	A list of permitted commercial oil disposal facilities in Wyoming.	Data	Wyoming DEQ	03/19/2014	Wyoming DEQ. 2014. Permitted Commercial Oil Disposal Facilities. http://deq.state.wy.us/wqd/www/Docs/Active%20COWDF.pdf.	Centralized Waste Treaters	1	No	No	CWT00095

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1.5	EPA-HQ-OW-2015-0665-1029	Radium Content of Oil and Gas-Field Produced Waters in the Northern Appalachian Basin (USA): Summary and Discussion of Data DCN CWT00316	Radium activity data for produced water from oil and gas operations in PA and NY. When available, TDS, gross alpha, and gross beta particles data was included.	Report	Rowan, E.; Engle, C.; Kraemer	01/01/2011	Rowan, E.L., et al. 2011. Radium content of oil and gas field produced waters in the northern App Basin. USGS Scientific Investigations Report 2011–5135.	Centralized Waste Treaters	38	No	No	CWT00316
1.5	EPA-HQ-OW-2015-0665-1033	Development and Use of High-TDS Recycled Produced Water for Crosslinked-Gel-Based Hydraulic Fracturing - DCN CWT00321	This paper describes use of treated produced water as the base fluid for crosslinked-gel-based hydraulic fracturing.	Publication; Copyrighted Material	Lord, LeBas	02/04/2013	Lord, R. LeBas; Luna, D.; Shahan, T. 2013. Development and Use of High-TDS Recycled Produced Water for Crosslinked-Gel-Based Hydraulic Fracturing.	Centralized Waste Treaters	9	No	Yes	CWT00321
1.5	EPA-HQ-OW-2015-0665-1110	Geochemical and Strontium Isotope Characterization of Produced Waters from Marcellus Shale Natural Gas Extraction DCN CWT00326	Identify and quantify the interaction of Marcellus Formation produced waters with other Appalachian Basin waters in the event of an accidental release.	Publication; Copyrighted Material	Campbell, E., et al	01/01/2012	Campbell, E., et al. 2012. Geochemical and Strontium Isotope Characterization of Produced Waters from Marcellus Shale Natural Gas Extraction	Centralized Waste Treaters	9	No	Yes	CWT00326

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1.5	EPA-HQ-OW-2015-0665-1114	What Chemicals Are Used DCN CWT00330	List of fracking chemicals	Publication; Copyrighted Material	FracFocus	01/01/2014	FracFocus. 2014. What Chemicals Are Used?	Centralized Waste Treaters	2	No	No	CWT00330
1.5	EPA-HQ-OW-2015-0665-1063	Advanced Well Stimulation Technologies in California: An Independent Review of Scientific and Technical Information DCN CWT00331	California council on Science and Technology's independent review of advanced well stimulation technologies in California. Report includes information on advanced well stimulation technologies, and historic and current applications.	Publication; Copyrighted Material	California Council on Science and Technolo	08/28/2014	CCST. 2014. Advanced Well Stimulation Technologies in California: An Independent Review of Scientific and Technical Information.	Centralized Waste Treaters	400	No	No	CWT00331
1.5	EPA-HQ-OW-2015-0665-0973	Northern Great Plains Water Consortium (NGPWC): Bakken Water Opportunities Assessment. North Dakota Petroleum Council Annual Meeting. (September) DCN CWT00337	Northern Great Plains Water Consortium Bakken water opportunities assessment presentation. Looked at potential to recycle frac flowback water in Bakken play. Includes discussion of Bakken water opportunities, project status, information on flowback.	Meeting or Teleconference Materials	Harju, John	01/01/2009	Harju, John. EERC (NGPWC) Bakken Water Opportunities Assessment North Dakota Petroleum Council Annual Meeting September 2009.	Centralized Waste Treaters	25	No	No	CWT00337

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1.5	EPA-HQ-OW-2015-0665-0979	Draft: Supplemental Generic Environmental Impact Statement (SGEIS) on the Oil, Gas, and Solution Mining Regulatory Program DCN CWT00343	A preliminary draft report discussing an EIS on oil, gas, and solution mining. Focuses on "Well Permit Issuance for Horizontal Drilling And High-Volume Hydraulic Fracturing to Develop the Marcellus Shale and Other Low-Permeability Gas Reservoirs".	Publication; Other Governmental	New York State Department of Environmental	09/01/2009	NYSDEC. 2009. Supplemental Generic Environmental Impact Statement (SGEIS) on the Oil, Gas, and Solution Mining Regulatory Program.	Centralized Waste Treaters	804	No	No	CWT00343
1.5	EPA-HQ-OW-2015-0665-0980	Organic compounds in produced waters from shale gas wells DCN CWT00344	A detailed analysis is reported of the organic composition of produced water samples from typical shale gas wells in the Marcellus (PA), Eagle Ford (TX), and Barnett (NM) formations.	Publication; Other Governmental	Maguire-Boyle, S.J. and Barron, A.R.	08/13/2014	Maguire-Boyle, S.J. and Barron, A.R. 2014. Organic compounds in produced waters from shale gas wells. Royal Society of Chemistry.	Centralized Waste Treaters	12	No	No	CWT00344
1.5	EPA-HQ-OW-2015-0665-0987	Baseline Groundwater Quality Testing Needs in the Eagle Ford Shale Region April 2012 DCN CWT00352	Masters project discussing whether existing baseline groundwater quality data in the Eagle Ford shale region of southern Texas is adequate to provide a comparison to potential future contamination from oil and gas development.	Report	Palacios, Virginia	04/01/2012	Palacios, Virginia. 2012. Baseline Groundwater Quality Testing Needs in the Eagle Ford Shale Region April 2012	Centralized Waste Treaters	88	No	No	CWT00352

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2.0	EPA-HQ-OW-2015-0665-0673	OCD Permitting: Well Search - DCN CWT00230	Searchable online production database.	Publication; Other Governmental	New Mexico Energy, Minerals and Natural Re	01/01/2014	New Mexico Energy, Minerals and Natural Resources Department (NMEMND). 2014. OCD Permitting: Well Search.	Centralized Waste Treaters	3	No	No	CWT00230
2.0	EPA-HQ-OW-2015-0665-0673.1	Copyright data clarification for US EPA (NM EMNRD) DCN CWT00230.A01	Permission from New Mexico Energy, Minerals and Natural Resources Department for EPA to publish their data.	E-mail	Wade, Gabriel	02/19/2015	Wade, Gabriel. 2015. Copyright data clarification for US EPA (NM EMNRD).	Centralized Waste Treaters	4	No	No	CWT00230.A1
2.0	EPA-HQ-OW-2015-0665-0710	Question on Southwestern NPDES Facilities DCN CWT00272	An email exchange between EPA and Southwestern Energy regarding their CWT Facilities.	E-mail	Fyfe, Peter	07/25/2016	Fyfe, Peter. 2016. Question on Southwestern NPDES Facilities. Southwestern Energy. (July 25).	Centralized Waste Treaters	2	No	No	CWT00272

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2.0	EPA-HQ-OW-2015-0665-0711	General Permit WMGR123 Processing and Beneficial Use Of Oil and Gas Liquid Waste DCN CWT00273	Permit information including definitions, requirements, and contact information.	Permit, Registration	Pennsylvania Department of Environmental P	03/14/2012	PA DEP. 2012. General Permit WMGR123 Processing and Beneficial Use Of Oil and Gas Liquid Waste. Rev. 3/2012.	Centralized Waste Treaters	13	No	No	CWT00273
2.1	EPA-HQ-OW-2015-0665-0634	Waste Management Paper #2-24 - DCN CWT00130	Working paper of the NPC North American Resource Development Study. Report on waste management in oil and gas exploration and production. Includes background on drilling wastes and a description of waste management techniques.	Report	National Petroleum Council (NPC)	09/15/2011	National Petroleum Council (NPC). 2011. Waste Management Paper #2-24. Technology Subgroup of the Operations & Environment Task Group. (September 15).	Centralized Waste Treaters	33	No	No	CWT00130
2.1	EPA-HQ-OW-2015-0665-0568	Discharge Monitoring Report Pollutant Loading Tool - DCN CWT00135	Screen shot of the EPA's Discharge Monitoring Report Pollutant Tool Facility Search page.	Publication; USEPA	U.S. EPA	06/17/2016	U.S. EPA. 2016. Discharge Monitoring Report (DMR) Pollutant Loading Tool. Accessed on 6/17/2016. Available online at: http://cfpub.epa.gov/dmr/	Centralized Waste Treaters	1	No	No	CWT00135

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2.1	EPA-HQ-OW-2015-0665-0570	CBI_DI Desktop® March 2015 Download - DCN CWT00145	CBI_Nationwide database of oil and gas wells. This is proprietary data and is being treated as CBI.	Publication; Copyrighted Material	DrillingInfo, Inc.	03/30/2015	DrillingInfo, Inc. 2015. DI Desktop® March 2015 Download_CBI.	Centralized Waste Treaters	1	Yes	Yes	CWT00145
2.1	EPA-HQ-OW-2015-0665-0727	Facility Call: Hibbard Tank Pad DCN CWT00288	A summary of a call with a CWT facility.	Meeting or Teleconference Materials	ERG	08/03/2016	ERG. 2016. Facility Call: Hibbard Tank Pad.	Centralized Waste Treaters	1	No	No	CWT00288
2.1	EPA-HQ-OW-2015-0665-0728	Facility Call: R360 Environmental Solutions DCN CWT00289	A summary of a call with a CWT facility.	Meeting or Teleconference Materials	ERG	08/03/2016	ERG. 2016. Facility Call: R360 Environmental Solutions.	Centralized Waste Treaters	1	No	No	CWT00289

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2.1	EPA-HQ-OW-2015-0665-0729	Facility Call: Waste Control Specialists, LLC DCN CWT00291	A summary of a call with a CWT facility.	Meeting or Teleconference Materials	ERG	08/03/2016	ERG. 2016. Facility Call: Waste Control Specialists, LLC.	Centralized Waste Treaters	1	No	No	CWT00291
2.1	EPA-HQ-OW-2015-0665-0731	Waste Treatment Corporation DCN CWT00293	Information about the facility provided by the point of contact.	Fact/Data Sheet	Kelly Roddy	06/03/2016	Kelly Roddy. 2016. Waste Treatment Corporation.	Centralized Waste Treaters	8	No	No	CWT00293
2.10	EPA-HQ-OW-2015-0665-0733	Environmental Engineering Support for Clean Water Regulations Programmatic Quality Assurance Project Plan (PQAPP) DCN CWT00295	ERG's Environmental Engineering Support for Clean Water Regulation Programmatic Quality Assurance Project Plan. Outlines quality assurance/quality control procedures followed under the contract.	Report	ERG	10/01/2013	ERG. 2013. Environmental Engineering Support for Clean Water Regulations Programmatic Quality Assurance Project Plan (PQAPP).	Centralized Waste Treaters	127	No	No	CWT00295

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2.3	EPA-HQ-OW-2015-0665-0603	Site Visit Report for Nuverra Appalachian Water Services, Masontown, PA, Centralized Waste Treatment - DCN CWT00062	A site visit report that summarizes Nuverra Appalachian Water Services' operations in Masontown, PA.	Publication; USEPA	U.S. EPA	01/25/2014	U.S. EPA. 2014. Site Visit Report for Nuverra Appalachian Water Services, Masontown, PA, Centralized Waste Treatment. (January 25).	Centralized Waste Treaters	18	No	No	CWT00062
2.3	EPA-HQ-OW-2015-0665-0604	Site Visit Report for Reserved Environmental Services, LLC, Mt. Pleasant, PA, Centralized Waste Treatment - DCN CWT00063	A site visit report that summarizes Reserved Environmental Services, LLC's operations in Mt. Pleasant, PA.	Publication; USEPA	U.S. EPA	02/10/2015	U.S. EPA. 2015. Site Visit Report for Reserved Environmental Services, LLC, Mt. Pleasant, PA, Centralized Waste Treatment. (February 10).	Centralized Waste Treaters	29	No	No	CWT00063
2.3	EPA-HQ-OW-2015-0665-0605	Site Visit Report for Patriot Water Treatment LLC, Warren, OH, Centralized Waste Treatment Facility - DCN CWT00064	A site visit report that summarizes Patriot Water Treatment LLC operations in Warren, OH.	Publication; USEPA	U.S. EPA	03/03/2015	U.S. EPA. 2015. Site Visit Report for Patriot Water Treatment LLC, Warren, OH, Centralized Waste Treatment Facility. (March 3).	Centralized Waste Treaters	51	No	No	CWT00064

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2.3	EPA-HQ-OW-2015-0665-0627	Sanitized Site Visit Report Chesapeake Energy Corporation Marcellus Shale Gas Operations - DCN CWT00111	The Chesapeake Marcellus Shale site was visited by EPA during the UOG rulemaking. The site visit was the first in a series of site visits that the EPA plans for this industry. During the site visits, EPA viewed a range of shale gas operations.	Publication; USEPA	U.S. EPA	02/06/2015	U.S. EPA. 2015. Sanitized Site Visit Report Chesapeake Energy Corporation Marcellus Shale Gas Operations (Sanitized).	Centralized Waste Treaters	42	No	No	CWT00111
2.3	EPA-HQ-OW-2015-0665-0631	CBI_Fairmont Brine Site Visit Report - DCN CWT00116	CBI_Fairmont Brine Site Visit Report	Report	ERG	05/26/2016	ERG. 2016. Fairmont Brine Site Visit Report.	Centralized Waste Treaters	1	Yes	No	CWT00116
2.3	EPA-HQ-OW-2015-0665-0742	CBI_Enclosure 7_NGL Anticline_Site Visit Report - DCN CWT00152.pdf	CBI_Enclosure 7_NGL Anticline_Site Visit Report	Report	ERG	07/11/2016	ERG. 2016. CBI_Enclosure 7_NGL Anticline_Site Visit Report.	Centralized Waste Treaters	1	Yes	No	CWT00152

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2.3	EPA-HQ-OW-2015-0665-0687	Notes on Meeting with Hydrozonix, LLC on 7 February 2014 - DCN CWT00241	A summary of a telephone conference between ERG and Hydrozonix about their advanced oxidation treatment technology.	Meeting Materials	ERG	03/07/2014	ERG. 2014. Ruminski, Brent. Notes on Call with Hydrozonix, LLC on 7 February 2014. (March 7.)	Centralized Waste Treaters	9	No	No	CWT00241
2.3	EPA-HQ-OW-2015-0665-0967	Sanitized Site Visit Report Southwestern Energy Fayetteville Shale Operations DCN CWT00266	Site Visit Report generated during the UOG rulemaking	Publication; USEPA	U.S. EPA	02/11/2015	U.S. EPA. 2015. Sanitized Site Visit Report Southwestern Energy Fayetteville Shale Operations.	Centralized Waste Treaters	35	No	No	CWT00266
2.3	EPA-HQ-OW-2015-0665-0735	Sanitized Site Visit Report for McCutcheon Enterprises Inc. Apollo, PA - Centralized Waste Treatment - DCN CWT00307	EPA is studying management of wastewaters from oil and gas extraction activities by CWT facilities. The recent increase in shale oil and shale gas extraction activities through practices such as hydraulic fracturing has increased needs.	Report	U.S. EPA	05/27/2015	U.S. EPA. 2015. Sanitized Site Visit Report for McCutcheon Enterprises Inc. Apollo, PA - Centralized Waste Treatment.	Centralized Waste Treaters	16	No	No	CWT00307

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2.3	EPA-HQ-OW-2015-0665-0965	Sanitized Eureka Site Visit Report DCN CWT00308	This site visit report summarizes information collected during EPA's site visit to Eureka Resources in Williamsport, PA. Eureka operates a CWT that utilizes evaporation/condensation to treat Marcellus wastewater and discharges to a local POTW.	Report	ERG	03/10/2017	ERG. 2017. Sanitized Eureka Site Visit Report.	Centralized Waste Treaters	28	No	No	CWT00308
2.3	EPA-HQ-OW-2015-0665-0736	Sanitized Meeting Report Altela, Inc. and Clarion Altela Environmental Services (CAES) Clarion, PA - DCN CWT00310	This report summarizes information collected during EPA's meeting with Altela, Inc.	Publication; USEPA	U.S. EPA	05/17/2017	U.S. EPA. 2017. Sanitized Meeting Report Altela, Inc. and Clarion Altela Environmental Services (CAES) Clarion, PA.	Centralized Waste Treaters	9	No	No	CWT00310
2.4	EPA-HQ-OW-2015-0665-0745	CBI_Anticline Sampling Episode Report - DCN CWT00161	CBI_Anticline Sampling Episode Report	Report	ERG	11/15/2016	ERG. 2016. Anticline Sampling Episode Report.	Centralized Waste Treaters	1	Yes	No	CWT00161

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2.4	EPA-HQ-OW-2015-0665-0746	CBI_Eureka Sampling Episode Report - DCN CWT00162	CBI_Eureka Sampling Episode Report	Report	ERG	11/15/2016	ERG. 2016. Eureka Sampling Episode Report.	Centralized Waste Treaters	1	Yes	No	CWT00162
2.6	EPA-HQ-OW-2015-0665-0696	COGIS - Production Database DCN CWT00255	Searchable online production database.	Data	Colorado Oil and Gas Conservation Commissi	02/25/2015	Colorado Oil and Gas Conservation Commission (COGCC). 2015. COGIS - Production Database.	Centralized Waste Treaters	1	No	No	CWT00255
2.6	EPA-HQ-OW-2015-0665-0697	Pennsylvania Department of Environmental Protection's Statewide Oil and Gas Waste Reports DCN CWT00257	ERG memorandum listing the oil and gas waste reports downloaded from the PA DEP on 12/22/2014, 11/12/2015, and 8/2/2016.	Memorandum	Eastern Research Group	08/02/2016	ERG. 2016. Pennsylvania Department of Environmental Protection's (PA DEP) Statewide Oil and Gas Waste Reports. (August)	Centralized Waste Treaters	6	No	No	CWT00257

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2.6	EPA-HQ-OW-2015-0665-0697.01	Statewide Data Downloads by Reporting Period - Attachment 1: Jan-Dec 2015 Waste (Conventional wells) DCN CWT00257.A01	PA DEP Jan - Dec 2015 oil and gas waste report for conventional wells.	Data	Pennsylvania Department of Environmental P	08/02/2016	PA DEP. 2016. Statewide Data Downloads by Reporting Period - Attachment 1: Jan-Dec 2015 Waste (Conventional wells). (Aug 2)	Centralized Waste Treaters	1	No	No	CWT00257.A01
2.6	EPA-HQ-OW-2015-0665-0697.02	Statewide Data Downloads by Reporting Period - Attachment 2: Jan-Jun 2015 Waste (Unconventional wells) DCN CWT00257.A02	PA DEP Jan - Jun 2015 oil and gas waste report for unconventional wells.	Data	Pennsylvania Department of Environmental P	08/02/2016	PA DEP. 2016. Statewide Data Downloads by Reporting Period - Attach. 2: Jan-Jun 2015 Waste (Unconventional wells). (Aug 2).	Centralized Waste Treaters	1	No	No	CWT00257.A02
2.6	EPA-HQ-OW-2015-0665-0697.03	Statewide Data Downloads by Reporting Period - Attachment 3: Jul-Dec 2015 Waste (Unconventional wells) DCN CWT00257.A03	PA DEP Jul - Dec 2015 oil and gas waste report for unconventional wells.	Data	Pennsylvania Department of Environmental P	08/02/2016	PA DEP. 2016. Statewide Data Downloads by Reporting Period - Attach. 3: Jul-Dec 2015 Waste (Unconventional wells). (Aug 2).	Centralized Waste Treaters	1	No	No	CWT00257.A03

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2.6	EPA-HQ-OW-2015-0665-0697.04	Statewide Data Downloads by Reporting Period - Attachment 4: Jan-Dec 2014 Waste (Conventional wells) DCN CWT00257.A04	PA DEP Jan - Dec 2014 oil and gas waste report for conventional wells.	Data	Pennsylvania Department of Environmental P	11/12/2015	PA DEP. 2015. Statewide Data Downloads by Reporting Period - Attachment 4: Jan-Dec 2014 Waste (Conventional wells). (Nov 12)	Centralized Waste Treaters	1	No	No	CWT00257.A04
2.6	EPA-HQ-OW-2015-0665-0697.05	Statewide Data Downloads by Reporting Period - Attachment 5: Jan-Jun 2014 Waste (Unconventional wells) DCN CWT00257.A0	PA DEP Jan - Jun 2014 oil and gas waste report for unconventional wells.	Data	Pennsylvania Department of Environmental P	12/22/2014	PA DEP. 2014. Statewide Data Downloads by Reporting Period - Attach. 5: Jan-Jun 2014 Waste (Unconventional wells). (Dec. 22).	Centralized Waste Treaters	1	No	No	CWT00257.A05
2.6	EPA-HQ-OW-2015-0665-0697.06	Statewide Data Downloads by Reporting Period - Attachment 6: Jul-Dec 2014 Waste (Unconventional wells) DCN CWT00257.A0	PA DEP Jul - Dec 2014 oil and gas waste report for unconventional wells.	Data	Pennsylvania Department of Environmental P	11/12/2015	PA DEP. 2015. Statewide Data Downloads by Reporting Period - Attach. 6: Jul-Dec 2014 Waste (Unconventional wells). (Nov 12).	Centralized Waste Treaters	1	No	No	CWT00257.A06

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2.6	EPA-HQ-OW-2015-0665-0697.07	Statewide Data Downloads by Reporting Period - Attachment 7: Jan-Dec 2013 Waste (Conventional wells) DCN CWT00257.A07	PA DEP Jan - Dec 2013 oil and gas waste report for conventional wells.	Data	Pennsylvania Department of Environmental P	12/22/2014	PA DEP. 2014. Statewide Data Downloads by Reporting Period - Attachment 7: Jan-Dec 2013 Waste (Conventional wells). (Dec. 22).	Centralized Waste Treaters	1	No	No	CWT00257.A07
2.6	EPA-HQ-OW-2015-0665-0697.08	Statewide Data Downloads by Reporting Period - Attachment 8: Jan-Jun 2013 Waste (Unconventional wells) DCN CWT00257.A08	PA DEP Jan - Jun 2013 oil and gas waste report for unconventional wells.	Data	Pennsylvania Department of Environmental P	12/22/2014	PA DEP. 2014. Statewide Data Downloads by Reporting Period - Attachment 8: Jan-Jun 2013 Waste (Unconventional wells). (Dec. 22).	Centralized Waste Treaters	1	No	No	CWT00257.A08
2.6	EPA-HQ-OW-2015-0665-0697.09	Statewide Data Downloads by Reporting Period - Attachment 9: Jul-Dec 2013 Waste (Unconventional wells) DCN CWT00257.A09	PA DEP Jul - Dec 2013 oil and gas waste report for unconventional wells.	Data	Pennsylvania Department of Environmental P	12/22/2014	PA DEP. 2014. Statewide Data Downloads by Reporting Period - Attachment 9: Jul-Dec 2013 Waste (Unconventional wells). (Dec. 22).	Centralized Waste Treaters	1	No	No	CWT00257.A09

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2.6	EPA-HQ-OW-2015-0665-0697.10	Statewide Data Downloads by Reporting Period - Attachment 10: Jan-Dec 2012 Waste (Conventional wells) DCN CWT00257.A10	PA DEP Jan - Dec 2012 oil and gas waste report for conventional wells.	Data	Pennsylvania Department of Environmental P	12/22/2014	PA DEP. 2014. Statewide Data Downloads by Reporting Period - Attachment 10: Jan-Dec 2012 Waste (Conventional wells). (Dec. 22).	Centralized Waste Treaters	1	No	No	CWT00257.A10
2.6	EPA-HQ-OW-2015-0665-0697.11	Statewide Data Downloads by Reporting Period - Attachment 11: Jan-Jun 2012 Waste (Unconventional wells) DCN CWT00257.A11	PA DEP Jan - Jun 2012 oil and gas waste report for unconventional wells.	Data	Pennsylvania Department of Environmental P	12/22/2014	PA DEP. 2014. Statewide Data Downloads by Reporting Period - Attachment 11: Jan-Jun 2012 Waste (Unconventional wells). (Dec. 22).	Centralized Waste Treaters	1	No	No	CWT00257.A11
2.6	EPA-HQ-OW-2015-0665-0697.12	Statewide Data Downloads by Reporting Period - Attachment 12: Jul-Dec 2012 Waste (Unconventional wells) DCN CWT00257.A12	PA DEP July - Dec 2012 oil and gas waste report for unconventional wells.	Data	Pennsylvania Department of Environmental P	12/22/2014	PA DEP. 2014. Statewide Data Downloads by Reporting Period - Attachment 12: Jul-Dec 2012 Waste (Unconventional wells). (Dec. 22).	Centralized Waste Treaters	1	No	No	CWT00257.A12

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2.6	EPA-HQ-OW-2015-0665-0697.13	Statewide Data Downloads by Reporting Period - Attachment 13: Jan-Dec 2011 Waste (Annual O&G, without Marcellus) DCN CWT00257.A13	PA DEP Jan - Dec 2011 oil and gas waste report for Annual O&G without Marcellus.	Data	Pennsylvania Department of Environmental P	12/22/2014	PA DEP. 2014. Statewide Data Downloads by Reporting Period- Att. 13: Jan-Dec 2011 Waste (Annual O&G, without Marcellus). (Dec 22).	Centralized Waste Treaters	1	No	No	CWT00257.A13
2.6	EPA-HQ-OW-2015-0665-0697.14	Statewide Data Downloads by Reporting Period - Attachment 14: Jan-Jun 2011 Waste (Marcellus Only, 6 months) DCN CWT00257.A14	PA DEP Jan - Jun 2011 oil and gas waste report for Marcellus only.	Data	Pennsylvania Department of Environmental P	12/22/2014	PA DEP. 2014. Statewide Data Downloads by Reporting Period - Att. 14: Jan-Jun 2011 Waste (Marcellus Only, 6 months). (Dec. 22).	Centralized Waste Treaters	1	No	No	CWT00257.A14
2.6	EPA-HQ-OW-2015-0665-0697.15	Statewide Data Downloads by Reporting Period - Attachment 15: Jul-Dec 2011 Waste (Marcellus Only, 6 months) DCN CWT00257.A15	PA DEP July - Dec 2011 oil and gas waste report for Marcellus only.	Data	Pennsylvania Department of Environmental P	12/22/2014	PA DEP. 2014. Statewide Data Downloads by Reporting Period - Att. 15: Jul-Dec 2011 Waste (Marcellus Only, 6 months). (Dec. 22).	Centralized Waste Treaters	1	No	No	CWT00257.A15

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2.6	EPA-HQ-OW-2015-0665-0697.16	Statewide Data Downloads by Reporting Period - Attachment 16: Jan-Dec 2010 Waste (Annual O&G, without Marcellus) DCN CWT00257.A16	PA DEP Jan - Dec 2010 oil and gas waste report for Annual O&G without Marcellus.	Data	Pennsylvania Department of Environmental P	12/22/2014	PA DEP. 2014. Statewide Data Downloads by Reporting Period- Att. 16: Jan-Dec 2010 Waste (Annual O&G, w/o Marcellus). (Dec 22).	Centralized Waste Treaters	1	No	No	CWT00257.A16
2.6	EPA-HQ-OW-2015-0665-0697.17	Statewide Data Downloads by Reporting Period - Attachment 17: Jul-Dec 2010 Waste (Marcellus Only, 6 months) DCN CWT00257.A17	PA DEP July - Dec 2010 oil and gas waste report for Marcellus only.	Data	Pennsylvania Department of Environmental P	12/22/2014	PA DEP. 2014. Statewide Data Downloads by Reporting Period - Att. 17: Jul-Dec 2010 Waste (Marcellus Only, 6 months). (Dec. 22).	Centralized Waste Treaters	1	No	No	CWT00257.A17
2.6	EPA-HQ-OW-2015-0665-0697.18	Statewide Data Downloads by Reporting Period - Attachment 18: Jul 2009-Jun 2010 Waste (Marcellus Only, 12 months) DCN CWT00257.A18	PA DEP Jul 2009 - Jun 2010 oil and gas waste report for Marcellus only.	Data	Pennsylvania Department of Environmental P	12/22/2014	PA DEP. 2014. Statewide Data Downloads by Reporting Period- Att. 18: Jul 2009- Jun 2010 Waste (Marcellus Only, 12 mos.). (Dec 22).	Centralized Waste Treaters	1	No	No	CWT00257.A18

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2.6	EPA-HQ-OW-2015-0665-0697.19	Statewide Data Downloads by Reporting Period - Attachment 19: Jan-Dec 2009 Waste (Annual O&G, with Marcellus) DCN CWT00257.A19	PA DEP Jan - Dec 2009 oil and gas waste report for Annual O&G with Marcellus.	Data	Pennsylvania Department of Environmental P	12/22/2014	PA DEP. 2014. Statewide Data Downloads by Reporting Period- Att. 19: Jan-Dec 2009 Waste (Annual O&G, with Marcellus). (Dec. 22).	Centralized Waste Treaters	1	No	No	CWT00257.A19
2.6	EPA-HQ-OW-2015-0665-0697.20	Statewide Data Downloads by Reporting Period - Attachment 20: Jan-Dec 2008 Waste (Annual O&G, with Marcellus) DCN CWT00257.A20	PA DEP Jan - Dec 2008 oil and gas waste report for Annual O&G with Marcellus.	Data	Pennsylvania Department of Environmental P	12/22/2014	PA DEP. 2014. Statewide Data Downloads by Reporting Period- Att. 20: Jan-Dec 2008 Waste (Annual O&G, with Marcellus). (Dec. 22).	Centralized Waste Treaters	1	No	No	CWT00257.A20
2.6	EPA-HQ-OW-2015-0665-0697.21	Statewide Data Downloads by Reporting Period - Attachment 21: Jan-Dec 2007 Waste (Annual O&G, with Marcellus) DCN CWT00257.A21	PA DEP Jan - Dec 2007 oil and gas waste report for Annual O&G with Marcellus.	Data	Pennsylvania Department of Environmental P	12/22/2014	PA DEP. 2014. Statewide Data Downloads by Reporting Period- Att. 21: Jan-Dec 2007 Waste (Annual O&G, with Marcellus). (Dec. 22).	Centralized Waste Treaters	1	No	No	CWT00257.A21

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2.6	EPA-HQ-OW-2015-0665-0697.22	Statewide Data Downloads by Reporting Period - Attachment 22: Jan-Dec 2006 Waste (Annual O&G, with Marcellus) DCN CWT00257.A22	PA DEP Jan - Dec 2006 oil and gas waste report for Annual O&G with Marcellus.	Data	Pennsylvania Department of Environmental P	12/22/2014	PA DEP. 2014. Statewide Data Downloads by Reporting Period-Att. 22: Jan-Dec 2006 Waste (Annual O&G, with Marcellus). (Dec. 22).	Centralized Waste Treaters	1	No	No	CWT00257.A22
2.6	EPA-HQ-OW-2015-0665-0697.23	Statewide Data Downloads by Reporting Period - Attachment 23: Jan-Dec 2005 Waste (Annual O&G, with Marcellus) DCN CWT00257.A23	PA DEP Jan - Dec 2005 oil and gas waste report for Annual O&G with Marcellus.	Data	Pennsylvania Department of Environmental P	12/22/2014	PA DEP. 2014. Statewide Data Downloads by Reporting Period-Att. 23: Jan-Dec 2005 Waste (Annual O&G, with Marcellus). (Dec. 22).	Centralized Waste Treaters	1	No	No	CWT00257.A23
2.6	EPA-HQ-OW-2015-0665-0697.24	Statewide Data Downloads by Reporting Period - Attachment 24: Jan-Dec 2004 Waste (Annual O&G, with Marcellus) DCN CWT00257.A24	PA DEP Jan - Dec 2004 oil and gas waste report for Annual O&G with Marcellus.	Data	Pennsylvania Department of Environmental P	12/22/2014	PA DEP. 2014. Statewide Data Downloads by Reporting Period-Att. 24: Jan-Dec 2004 Waste (Annual O&G, with Marcellus). (Dec. 22).	Centralized Waste Treaters	1	No	No	CWT00257.A24

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2.6	EPA-HQ-OW-2015-0665-0697.25	Statewide Data Downloads by Reporting Period - Attachment 25: Jan-Dec 2003 Waste (Annual O&G, with Marcellus) DCN CWT00257.A25	PA DEP Jan - Dec 2003 oil and gas waste report for Annual O&G with Marcellus.	Data	Pennsylvania Department of Environmental P	12/22/2014	PA DEP. 2014. Statewide Data Downloads by Reporting Period- Att. 25: Jan-Dec 2003 Waste (Annual O&G, with Marcellus). (Dec. 22).	Centralized Waste Treaters	1	No	No	CWT00257.A25
2.6	EPA-HQ-OW-2015-0665-0697.26	Statewide Data Downloads by Reporting Period - Attachment 26: Jan-Dec 2002 Waste (Annual O&G, with Marcellus) DCN CWT00257.A26	PA DEP Jan - Dec 2002 oil and gas waste report for Annual O&G with Marcellus.	Data	Pennsylvania Department of Environmental P	12/22/2014	PA DEP. 2014 Statewide Data Downloads by Reporting Period- Att. 26: Jan-Dec 2002 Waste (Annual O&G, with Marcellus). (Dec. 22).	Centralized Waste Treaters	1	No	No	CWT00257.A26
2.6	EPA-HQ-OW-2015-0665-0697.27	Statewide Data Downloads by Reporting Period - Attachment 27: Jan-Dec 2001 Waste (Annual O&G, with Marcellus) DCN CWT00257.A27	PA DEP Jan - Dec 2001 oil and gas waste report for Annual O&G with Marcellus.	Data	Pennsylvania Department of Environmental P	12/22/2014	PA DEP. 2014. Statewide Data Downloads by Reporting Period- Att. 27: Jan-Dec 2001 Waste (Annual O&G, with Marcellus). (Dec. 22).	Centralized Waste Treaters	1	No	No	CWT00257.A27

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2.6	EPA-HQ-OW-2015-0665-0697.28	Statewide Data Downloads by Reporting Period - Attachment 28: Jan-Dec 2000 Waste (Annual O&G, with Marcellus) DCN CWT00257.A28	PA DEP Jan - Dec 2000 oil and gas waste report for Annual O&G with Marcellus.	Data	Pennsylvania Department of Environmental P	12/22/2014	PA DEP. 2014. Statewide Data Downloads by Reporting Period-Att. 28: Jan-Dec 2000 Waste (Annual O&G, with Marcellus). (Dec. 22).	Centralized Waste Treaters	1	No	No	CWT00257.A28
2.9	EPA-HQ-OW-2015-0665-0540	Produced Water Volumes and Management Practices in the United States - DCN CWT00014	Current estimate for the volume of produced water generated from oil and gas production in the United States. The volume estimate represents a compilation of data obtained from numerous state oil and gas agencies and several federal sources.	Publication; Other Governmental	Clark, C.E.; Veil, J.A.	09/01/2009	Clark, C.E.; Veil, J.A. 2009. Produced Water Volumes and Management Practices in the United States. Argonne National Laboratory. ANL/EVS/R-09/1.	Centralized Waste Treaters	65	No	No	CWT00014
2.9	EPA-HQ-OW-2015-0665-1060	Sanitized Eureka Standing Stone Sampling and Analysis Plan DCN CWT00309	This sampling plan summarizes EPA's approach to collecting and analyzing samples of treated wastewater from Eureka.	Report	ERG	03/10/2017	ERG. 2017. Sanitized Eureka Standing Stone Sampling and Analysis Plan.	Centralized Waste Treaters		No	No	CWT00309

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3.0	EPA-HQ-OW-2015-0665-0674	Conventional Oil and Gas (COG) Memorandum for the Record DCN CWT00128	This memorandum discusses conventional oil and gas (COG) extraction wastewater characteristics, as well as management and disposal practices used for COG extraction wastewater	Memorandum	ERG	06/01/2016	ERG. 2016. Conventional Oil and Gas Memorandum for the Record.	Centralized Waste Treaters	25	No	No	CWT00128
3.0	EPA-HQ-OW-2015-0665-0674.1	Conventional Oil and Gas (COG) Memorandum for the Record - Attachment 1: COG Drilling Wastewater Volume and Characterization Data - DCN CWT00128.A1	This file shows analysis on conventional oil and gas (COG) drilling wastewater characteristics.	Data	ERG	06/01/2016	ERG. 2016. Conventional Oil and Gas Memo for the Record - A01: COG Drilling Wastewater Volume and Characterization Data.	Centralized Waste Treaters	1	No	No	CWT00128.A1
3.0	EPA-HQ-OW-2015-0665-0674.2	Conventional Oil and Gas (COG) Memorandum for the Record - Attachment 2: COG Wastewater Characterization Analysis - DCN CWT00128.A2	This file shows analysis on conventional oil and gas (COG) produced water characteristics	Data	ERG	06/01/2016	ERG. 2016. Conventional Oil and Gas Memo for the Record - A02: COG Wastewater Characterization Analysis.	Centralized Waste Treaters	1	No	No	CWT00128.A2

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3.0	EPA-HQ-OW-2015-0665-0674.3	Conventional Oil and Gas (COG) Memorandum for the Record - Attachment 3: COG Wastewater Characterization Database - DCN CWT00128.A3	This file is the conventional oil and gas (COG) extraction wastewater database	Data	ERG	06/01/2016	ERG. 2016. Conventional Oil and Gas Memorandum for the Record - Attachment 3: COG Wastewater Characterization Database.	Centralized Waste Treaters	1	No	No	CWT00128.A3
3.0	EPA-HQ-OW-2015-0665-0674.4	Conventional Oil and Gas (COG) Memorandum for the Record - Attachment 4: USGS Produced Water Database - COG Data - DCN CWT00128.A4	This file is the conventional oil and gas (COG) produced water database from USGS	Data	ERG	06/01/2016	ERG. 2016. Conventional Oil and Gas Memorandum for the Record - Attachment 4: USGS Produced Waster Database - COG Data.	Centralized Waste Treaters	1	No	No	CWT00128.A4
3.0	EPA-HQ-OW-2015-0665-0572	Unconventional Oil and Gas Drilling Wastewater Memorandum - DCN CWT00148	Memorandum summarizing information available for UOG drilling wastewater volumes, characteristics, and management	Memorandum	ERG	06/01/2016	ERG. 2016. Unconventional Oil and Gas (UOG) Drilling Wastewater Memorandum.	Centralized Waste Treaters	20	No	No	CWT00148

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3.0	EPA-HQ-OW-2015-0665-0572.1	Unconventional Oil and Gas Drilling Wastewater Memorandum Attachment 1: UOG Drilling Wastewater Volume and Characterization Data Excel File - DCN CWT00148.A01	Analysis of information available for drilling wastewater volumes, characteristics, and management	Data	ERG	06/01/2016	ERG. 2016. Oil and Gas Drilling Wastewater Memorandum Attachment 1: UOG Drilling Wastewater Volume and Characterization Data Excel File.	Centralized Waste Treaters	1	No	No	CWT00148.A1
3.0	EPA-HQ-OW-2015-0665-0638	Decentralized Systems Technology Fact Sheet: Aerobic Treatment. - DCN CWT00200	Fact sheet for basic functionality and enhanced applicability for aerobic biological treatment.	Publication; USEPA	U.S. EPA	01/01/2000	U.S. EPA. 2000b. Decentralized Systems Technology Fact Sheet: Aerobic Treatment. Washington, D.C. (September).	Centralized Waste Treaters	8	No	No	CWT00200
3.0	EPA-HQ-OW-2015-0665-0645	Centralized Waste Treatment Facility List Approach Memo - DCN CWT00215	This memo outlines the steps taken by the EPA in creating a list of U.S. CWT facilities	Data	ERG	09/19/2015	ERG. 2015. Centralized Waste Treatment Facility List Approach Memo. (September 19).	Centralized Waste Treaters	34	No	No	CWT00215

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3.0	EPA-HQ-OW-2015-0665-0647	Economic Analysis of Effluent Limitations Guidelines and Standards for the Centralized Waste Treatment Industry DCN CWT00220	This report estimates the economic and financial effects and the benefits of compliance with the proposed effluent limitations guidelines and standards for the Centralized Waste Treatment (CWT) industry.	Analysis	U.S. EPA	01/01/2006	U.S. EPA. 2006. Economic Analysis of Effluent Limitations Guidelines and Standards for the Centralized Waste Treatment Industry.	Centralized Waste Treaters	238	No	No	CWT00220
3.0	EPA-HQ-OW-2015-0665-0667	Treatment Technologies Relevant to the Unconventional Oil and Gas Industry DCN CWT00227	On 08 November 2013, the U.S. Environmental Protection Agency (EPA), along with EPA's contractor, Eastern Research Group, Inc (ERG), held a meeting with Purestream Technology (Purestream) 1 to discuss treatment technologies relevant to the unconventional	Meeting or Teleconference Materials	ERG	11/08/2013	U.S. Environmental Protection Agency (U.S. EPA). 2013d. Treatment Technologies Relevant to the Unconventional Oil and Gas Industry.	Centralized Waste Treaters	11	No	No	CWT00227
3.0	EPA-HQ-OW-2015-0665-0690	CoilChem, LLC Treatment Technology Memorandum - DCN CWT00246	Memorandum to the Record Discussing Treatment Technology from CoilChem, LLC.	Memorandum	ERG	01/06/2016	ERG. 2016. CoilChem, LLC Treatment Technology Memorandum.	Centralized Waste Treaters	2	No	No	CWT00246

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3.0	EPA-HQ-OW-2015-0665-0968	Conventional Oil and Gas Data Gathering and Data Gaps Memorandum DCN CWT00274	The primary objectives of this memorandum are to identify Centralized Waste Treatment (CWT) facilities and Publicly Owned Treatment Works (POTWs) that have accepted or are still accepting conventional oil and gas (COG) extraction wastewater.	Memorandum	ERG	03/01/2017	ERG. 2017. Conventional Oil and Gas Data Gathering and Data Gaps Memorandum.	Centralized Waste Treaters	21	No	No	CWT00274
3.0	EPA-HQ-OW-2015-0665-0968.1	Conventional Oil and Gas Data Gathering and Data Gaps Memorandum - Attachment 1: Facility List and Analysis DCN CWT00274.A01	Lists of Centralized Waste Treatment (CWT) facilities and Publicly Owned Treatment Works (POTWs) that have accepted or are still accepting conventional oil and gas (COG) extraction wastewater.	Data	ERG	03/01/2017	ERG. 2017. Conventional Oil and Gas Data Gathering and Data Gaps Memorandum - Attachment 1: Facility List and Analysis.	Centralized Waste Treaters	0	No	No	CWT00274.A1
3.0	EPA-HQ-OW-2015-0665-0968.2	Conventional Oil and Gas Data Gathering and Data Gaps Memorandum - Attachment 2: PA DEP Waste Reports Analysis Database DCN CWT00274.A02	An analysis of PA DEP Waste Report data to identify Centralized Waste Treatment (CWT) facilities and Publicly Owned Treatment Works (POTWs) that have accepted or are still accepting conventional oil and gas (COG) extraction wastewater.	Data	ERG	03/01/2017	ERG. 2017. Conventional Oil and Gas Data Gathering and Data Gaps Memorandum - Attachment 2: PA DEP Waste Reports Analysis Database.	Centralized Waste Treaters	0	No	No	CWT00274.A2

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3.0	EPA-HQ-OW-2015-0665-0964	Centralized Waste Treatment Facilities Identified by the 304(m) 2014 Annual Review DCN CWT00275	A summary memo of facilities identified during the 2015 Annual Review process	Memorandum	ERG	05/11/2017	ERG. 2017. Centralized Waste Treatment Facilities Identified by the 304(m) 2014 Annual Review.	Centralized Waste Treaters	2	No	No	CWT00275
3.0	EPA-HQ-OW-2015-0665-0654	Wyoming Oil and Gas Conservation Commission (WY OGCC) Water Data Memorandum - Attachment 1: Raw Data from WY OGCC DCN CWT00363	Raw data from WY OGCC provided to ERG for analysis.	Data	WY OGCC	01/22/2015	WY OGCC. 2015. Wyoming Oil and Gas Conservation Commission (WY OGCC) Water Data Memorandum - Attachment 1: Raw Data from WY OGCC.	Centralized Waste Treaters	1	No	No	CWT00363
3.1	EPA-HQ-OW-2015-0665-0929	Proposed Approach for Data Analysis and Quality Assurance Using Drillinginfo's (DI) Desktop® Well File Database - DCN CWT00173	Memorandum that outlines the approach to using the DI Desktop Database	Memorandum	ERG	01/20/2016	ERG. 2016. Proposed Approach for Data Analysis and Quality Assurance Using Drillinginfo's (DI) Desktop® Well File Database.	Centralized Waste Treaters	7	No	No	CWT00173

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3.1	EPA-HQ-OW-2015-0665-0931	Centralized Waste Treatment Facility List Comment from EPA Regions Memorandum DCN CWT00256	A memo summarizing comments from state pretreatment coordinators regarding an early draft of the CWT Facility List.	Memorandum	Eastern Research Group	02/22/2016	ERG. 2017. Centralized Waste Treatment Facility List Comment from EPA Regions Memorandum.	Centralized Waste Treaters	4	No	No	CWT00256
3.1	EPA-HQ-OW-2015-0665-0659	Proposed Approach for Data Analysis and Quality Assurance Using Drillinginfo's (DI) Desktop® Well File Database DCN CWT00368	Memorandum that outlines the approach to using the DI Desktop Database	Memorandum	ERG	01/20/2016	ERG. 2016. Proposed Approach for Data Analysis and Quality Assurance Using Drillinginfo's (DI) Desktop® Well File Database.	Centralized Waste Treaters	7	No	No	CWT00368
4.0	EPA-HQ-OW-2015-0665-0702	Baker Hughes: US Rig Count Ticks up 2 Units to 931 DCN CWT00390	Article reporting the US drilling rig count for the week ending December 8, 2017, based on data from Baker Hughes.	Publication; Copyrighted Material	OGJ Editors	12/08/2017	Oil and Gas Journal. 2017. "Baker Hughes: US Rig Count Ticks up 2 Units to 931." December 8, 2017. Accessed December 14, 2017. Available electronically at: http://www.ogj.com/articles/2017/12/baker-hughes	Centralized Waste Treaters	2	No	Yes	CWT00390

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4.0	EPA-HQ-OW-2015-0665-0704	Annual Energy Outlook 2017 DCN CWT00394	EIA's Annual Energy Outlook 2017 provides modeled projections of domestic energy markets through 2050, and includes cases with different assumptions of macroeconomic growth, world oil prices, technological progress, and energy policies.	Publication; Other Governmental	U.S. DOE	01/05/2017	United States Department of Energy (U.S. DOE). 2017a. Energy Information Administration (EIA). Annual Energy Outlook 2017. Available electronically at: https://www.eia.gov/outlooks/archi	Centralized Waste Treaters	64	No	No	CWT00394
4.0	EPA-HQ-OW-2015-0665-0705	U.S. Dry Shale Gas Production DCN CWT00395	Estimated monthly dry shale gas production by play, derived from state administrative data. EIA defines shale gas as natural gas produced from wells that are open to shale formations. EIA defines dry natural gas production as the process of producing cons	Data	U.S. DOE	11/01/2017	United States Department of Energy (U.S. DOE). 2017b. Energy Information Administration (EIA). U.S. Dry Shale Gas Production. Accessed December 14, 2017. Available	Centralized Waste Treaters	0	No	No	CWT00395
4.0	EPA-HQ-OW-2015-0665-0722	Annual Energy Outlook 2016 Figure Data: Figure MT-46 DCN CWT00396	U.S. dry natural gas production by source in the Reference case, from EIA's 2016 Annual Energy Outlook. Production sources are: shale gas and tight oil plays, tight gas, lower 48 offshore, coalbed methane, Alaska, and other.	Data	U.S. DOE	10/25/2016	United States Department of Energy (U.S. DOE). 2016a. Energy Information Administration (EIA). Annual Energy Outlook 2016 Figure Data: Figure MT-46. U.S. dry natural gas	Centralized Waste Treaters	0	No	No	CWT00396

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4.0	EPA-HQ-OW-2015-0665-0723	U.S Tight Oil Production Estimates: Monthly DCN CWT00400	Estimated monthly right oil production derived from state administrative data. EIA defines tight oil as oil produced from petroleum-bearing formations with low permeability such a the Eagle Ford, the Bakken, and other formations that must be hydraulically	Data	U.S. DOE	04/01/2016	United States Department of Energy (U.S. DOE). 2016e. Energy Information Administration (EIA). U.S. Tight Oil Production Estimates: Monthly. Accessed April 27, 2016. Available	Centralized Waste Treaters	0	No	No	CWT00400
4.0	EPA-HQ-OW-2015-0665-0748	Economic and Financial Questionnaire DCN CWT00405	Blank financial and economic questionnaire sent to CWT facilities under authority of Section 308 of the Clean Water Act, soliciting financial information on items such as the business model of the facility and its ownership, operational and financial deci	Form	U.S. EPA	03/07/2016	United States Environmental Protection Agency (U.S. EPA). 2016. Blank 308 Questionnaire.	Centralized Waste Treaters	23	No	No	CWT00405
5	EPA-HQ-OW-2015-0665-1096	Nutrient Requirements of Beef Cattle DCN CWT00469	"The book clearly communicates the current state of beef cattle nutrient requirements and animal variation by visually presenting related data via computer-generated models."	Publication; Copyrighted Material	NRC	01/01/1996	NRC. 1996. Nutrient Requirements of Beef Cattle. 7th ed. National Research Council. National Academy Press, Washington, DC.	Centralized Waste Treaters	248	No	Yes	CWT00469

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5	EPA-HQ-OW-2015-0665-0956	Shale gas development impacts on surface water quality in Pennsylvania DCN CWT00470	"This paper conducts a large-scale examination of the extent to which shale gas development activities affect surface water quality. Focusing on the Marcellus Shale in Pennsylvania, we estimate the effect of shale gas wells and the release of treated shal	Fact/Data Sheet	Olmstead, S.M., L.A. Muehlenbachs, J-S. Sh	03/26/2013	Olmstead, S.M., L.A. Muehlenbachs, J-S. Shih, Z. Chu, and A.J. Krupnick. 2013. Shale gas development impacts on surface water quality in Pennsylvania. Proc. Natl Acad. Sci. USA	Centralized Waste Treaters	6	No	Yes	CWT00470
5	EPA-HQ-OW-2015-0665-0955	Subject: Cause and Effect Survey. South Fork Tenmile Creek, Marcellus Shale Natural Gas Drilling Waste Water Treatment, Waynesburg Pennsylvania, Greene County, Stream Code 40293 DCN CWT00471	"The purpose of the aquatic biological investigation was to examine and determine if the Warren Wastewater Treatment Plant (WWTP) and Waste Treatment Corporation (WTC) discharges are having negative impacts on the Alleghany River. Benthic macroinvertebrat	Letter	PA DEP	02/02/2009	PA DEP. 2009. Subject: Cause and Effect Survey. South Fork Tenmile Creek, Marcellus Shale Natural Gas Drilling Waste Water Treatment, Waynesburg Pennsylvania, Greene County, Stream Code	Centralized Waste Treaters	55	No	No	CWT00471
5	EPA-HQ-OW-2015-0665-0954	Aquatic Biology Investigation DCN CWT00472	"The purpose of the aquatic biological investigation was to examine and determine if the Warren Wastewater Treatment Plant (WWTP) and Waste Treatment Corporation (WTC) discharges are having negative impacts on the Alleghany River. Benthic macroinvertebrat	Publication; Other Governmental	PA DEP	01/10/2013	PA DEP. 2013. Aquatic Biology Investigation. Report. Pennsylvania Department of Environmental Protection. January.	Centralized Waste Treaters	20	No	No	CWT00472

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5	EPA-HQ-OW-2015-0665-0953	An Index of Biotic Integrity for Benthic Macroinvertebrate Communities in Pennsylvania's Wadeable, Freestone, Riffle-Run Streams DCN CWT00473	"The principal motivation for this project was to develop an index of biological integrity (IBI) for benthic macroinvertebrate communities in Pennsylvania's larger wadeable, freestone, riffle-run streams. This project builds on previous work to develop a	Publication; Other Governmental	PA DEP	01/01/2015	PA DEP. 2015. An Index of Biotic Integrity for Benthic Macroinvertebrate Communities in Pennsylvania's Wadeable, Freestone, Riffle-Run Streams. Pennsylvania Department of Environmental	Centralized Waste Treaters	22	No	No	CWT00473
5	EPA-HQ-OW-2015-0665-0952	Enhanced formation of disinfection byproducts in shale gas wastewater-impacted drinking water supplies DCN CWT00475	"This study evaluated the minimum volume percentage of two Marcellus Shale and one Fayetteville Shale HFWs diluted by fresh water collected from the Ohio and Allegheny Rivers that would generate and/or alter the formation and speciation of DBPs following	Publication; Copyrighted Material	Parker, K.M., T. Zeng, J. Harkness, A. Ven	09/09/2014	Parker, K.M., T. Zeng, J. Harkness, A. Vengosh, and W.A. Mitch. 2014. Enhanced formation of disinfection byproducts in shale gas wastewater-impacted drinking water supplies	Centralized Waste Treaters	9	No	Yes	CWT00475
5	EPA-HQ-OW-2015-0665-0951	Effects of high salinity wastewater discharges on unionid mussels in the Allegheny River, Pennsylvania DCN CWT00476	"We examined the effect of high salinity wastewater (brine) from oil and natural gas drilling on freshwater mussels in the Allegheny River, Pennsylvania, during 2012. Mussel cages (N = 5 per site) were deployed at two sites upstream and four sites downstr	Publication; Copyrighted Material	Patnode, K.A., E. Hittle, R.M. Anderson, L	06/01/2015	Patnode, K.A., E. Hittle, R.M. Anderson, L. Zimmerman, and J.W. Fulton. 2015. Effects of high salinity wastewater discharges on unionid mussels in the Allegheny River, Pennsylvania. Journal of Fish	Centralized Waste Treaters	16	No	Yes	CWT00476

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5	EPA-HQ-OW-2015-0665-0950	Effects of Water Quality on Beef Cattle DCN CWT00477	"Field observations from our laboratory since 1999 have shown both surface and subsurface water to be high in total dissolved solids (TDS, an estimate of total salts) and sulfates. In the midst of drought conditions in 2002, we observed surface water with	Meeting or Teleconference Materials	Patterson, T. and P. Johnson	12/09/2003	Patterson, T. and P. Johnson. 2003. Effects of Water Quality on Beef Cattle. Proceedings, The Range Beef Cow Symposium XVII December 9, 10, and 11. University of Nebraska-Lincoln. Available:	Centralized Waste Treaters	9	No	No	CWT00477
5	EPA-HQ-OW-2015-0665-0949	Treatment Requirements for New and Expanding Mass Loadings of Total Dissolved Solids (TDS) DCN CWT00478	"The following are not considered new and expanding mass loadings of TDS and are exempt from the treatment requirements in this section: (1) Maximum daily discharge loads of TDS or specific conductivity levels that were authorized by the Department pr	Guidance, Interpretation, Policy, Procedure	Pennsylvania Code	08/21/2010	Pennsylvania Code. 2011. § 95.10. Treatment Requirements for New and Expanding Mass Loadings of Total Dissolved Solids (TDS). Available: http://www.pacode.com/secure/data/025/chapter95/	Centralized Waste Treaters	4	No	No	CWT00478
5	EPA-HQ-OW-2015-0665-0948	Effect of bromide ion on formation of HAAs during chlorination DCN CWT00479	"A two-block full-factorial matrix was designed to statistically evaluate the influence of bromide ion on the formation and speciation of haloacetic acids (HAAs) during chlorination and the effects of independent variables, including pH, reaction time, an	Publication; Copyrighted Material	Pourmoghaddas, H., A.A. Stevens, R.N. Kinm	01/01/1993	Pourmoghaddas, H., A.A. Stevens, R.N. Kinman, R.C. Dressman, L.A. Moore, and J.C. Ireland. 1993. Effect of bromide ion on formation of HAAs during chlorination. Journal American Water	Centralized Waste Treaters	6	No	Yes	CWT00479

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5	EPA-HQ-OW-2015-0665-0947	Wastewater management and Marcellus shale gas development: Trends, drivers, and planning implications DCN CWT00480	"Here we examine wastewater management practices and trends for this shale play through analysis of industry-reported, publicly available data collected from the Pennsylvania Department of Environmental Protection Oil and Gas Reporting Website. We also an	Publication; Copyrighted Material	Rahm, B.G., J.T. Bates, L.R. Bertoia, A.E.	03/15/2013	Rahm, B.G., J.T. Bates, L.R. Bertoia, A.E. Galford, D.A. Yoxtheimer, and S.J. Riha. 2013. Wastewater management and Marcellus shale gas development: Trends, drivers, and planning implications	Centralized Waste Treaters	9	No	Yes	CWT00480
5	EPA-HQ-OW-2015-0665-0946	Water Quality for Wyoming Livestock and Wildlife. A Review of the Literature Pertaining to the Health Effects of Inorganic Contaminants DCN CWT00481	"This report, and the project that created it, was funded by the Wyoming Department of Environmental Quality.Although the authors anticipate they will find the information useful, our intended audience is much broaderand includes ranchers, wildlife mana	Study	Raisbeck, M.F., S.L. Riker, C.M. Tate, R.	01/01/2008	Raisbeck, M.F., S.L. Riker, C.M. Tate, R. Jackson, M.A. Smith, K.J. Reddy, and J.R. Zygmunt. 2008. Water Quality for Wyoming Livestock and Wildlife. A Review of the Literature Pertaining to the	Centralized Waste Treaters	100	No	No	CWT00481
5	EPA-HQ-OW-2015-0665-0945	Estimating potential increased bladder cancer risk due to increased bromide concentrations in sources of disinfected drinking water DCN CWT00482	"We estimate bladder cancer risk from potential increased bromide levels in source waters of disinfecting public drinking water systems in the United States. Bladder cancer is the health end point used by the United States Environmental Protection Agency	Publication; Copyrighted Material	Regli, S., J. Chen, M. Messner, M. Elovitz	10/21/2015	Regli, S., J. Chen, M. Messner, M. Elovitz, F. Letkiewicz, R. Pegram, T. Pepping, S. Richardson, and J. Wright. 2015. Estimating potential increased bladder cancer risk due to	Centralized Waste Treaters	9	No	Yes	CWT00482

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5	EPA-HQ-OW-2015-0665-0944	Occurrence, genotoxicity, and carcinogenicity of regulated and emerging disinfection by-products in drinking water: A review and roadmap for research DCN CWT00483	"Our analysis identified three categories of DBPs of particular interest. Category 1 contains eight DBPs with some or all of the toxicologic characteristics of human carcinogens: four regulated (bromodichloromethane, dichloroacetic acid, dibromoacetic aci	Publication; Copyrighted Material	Richardson, S.D., M.J. Plewa, E.D. Wagner,	01/01/2007	Richardson, S.D., M.J. Plewa, E.D. Wagner, R. Schoeny, and D.M. DeMarini. 2007. Occurrence, genotoxicity, and carcinogenicity of regulated and emerging disinfection by-products in	Centralized Waste Treaters	65	No	Yes	CWT00483
5	EPA-HQ-OW-2015-0665-0943	Water pollution risk associated with natural gas extraction from the Marcellus shale DCN CWT00485	"Using probability bounds analysis, we assessed the likelihood of water contamination from natural gas extraction in the Marcellus Shale. Probability bounds analysis is well suited when data are sparse and parameters highly uncertain. The study model iden	Publication; Copyrighted Material	Rozell, D.J. and S.J. Reaven	01/01/2012	Rozell, D.J. and S.J. Reaven. 2012. Water pollution risk associated with natural gas extraction from the Marcellus shale. Risk Analysis 32(8):1382–1393 . doi: 10.1111/j.1539-6924.2011.01757	Centralized Waste Treaters	12	No	Yes	CWT00485
5	EPA-HQ-OW-2015-0665-0942	Effects of Total Dissolved Solids on Aquatic Organisms: A Literature Review. Technical Report No. 01-06 DCN CWT00486	"Total dissolves solids (TDS) are naturally present in water or are the result of mining or some industrial treatment of water. TDS contain minerals and organic molecules that provide benefits such as nutrients or contaminants such as toxic metals and org	Publication; Other Governmental	Scannell, P.W. and L.L. Jacobs	06/01/2011	Scannell, P.W. and L.L. Jacobs. 2001. Effects of Total Dissolved Solids on Aquatic Organisms: A Literature Review. Technical Report No. 01-06. Alaska Department of Fish and Game	Centralized Waste Treaters	68	No	No	CWT00486

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5	EPA-HQ-OW-2015-0665-0941	Ecology of a saline stream: Community responses to spatial gradients of environmental conditions DCN CWT00487	"Spatial changes in structural and functional characteristics of fish and macroinvertebrate communities in eastern Kentucky were investigated in a drainage system chronically exposed to high levels of chloride salts from nearby oilfield operations. Salini	Publication; Copyrighted Material	Short, T., J. Black, and W. Birge	03/20/1991	Short, T., J. Black, and W. Birge. 1991. Ecology of a saline stream: Community responses to spatial gradients of environmental conditions. Hydrobiologia 226:167–178.	Centralized Waste Treaters	12	No	Yes	CWT00487
5	EPA-HQ-OW-2015-0665-0940	Hazard Identification for Human and Ecological Effects of Sodium Chloride Road Salt. I-93 Chloride TMDL Study. DCN CWT00488	"This paper presents a synthesis and interpretation of available literature on the effects of both sodium chloride roadsalt, including those of the sodium cation and chloride anion in the dissolved phase, on humans, wildlife, aquatic life, and vegetation	Publication; Other Governmental	Sigel, L	07/06/2007	Sigel, L. 2007. Hazard Identification for Human and Ecological Effects of Sodium Chloride Road Salt. I-93 Chloride TMDL Study. New Hampshire Department of Environmental Services	Centralized Waste Treaters	19	No	No	CWT00488
5	EPA-HQ-OW-2015-0665-0939	Surface disposal of produced waters in western and southwestern Pennsylvania: Potential for accumulation of alkali-earth elements in sediments DCN CWT00489	"Waters co-produced with hydrocarbons in the Appalachian Basin are of notably poor quality (concentrations of total dissolved solids (TDS) and total radium up to and exceeding 300,000 mg/L and 10,000 pCi/L, respectively). Since 2008, a rapid increase in M	Publication; Copyrighted Material	Skalak, K.J., M.A. Engle, E.L. Rowan, G.D.	12/12/2013	Skalak, K.J., M.A. Engle, E.L. Rowan, G.D. Jolly, K.M. Conko, A.J. Benthem, and T.F. Kraemer. 2014. Surface disposal of produced waters in western and southwestern Pennsylvania: Potential for	Centralized Waste Treaters	9	No	Yes	CWT00489

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5	EPA-HQ-OW-2015-0665-0938	Marcellus shale drilling and brominated THMs in Pittsburgh, Pa., drinking water DCN CWT00490	"In an effort to explain these changes, PWSA and the University of Pittsburgh's Swanson School of Engineering investigated bromide concentrations in the Allegheny River (PWSA's source water) and THM formation in PWSA's drinking water. Results of the inves	Publication; Copyrighted Material	States, S., G. Cyprych, M. Stoner, F. Wydr	05/03/2013	States, S., G. Cyprych, M. Stoner, F. Wydra, J. Kuchta, J. Monnell, and L. Casson. 2013. Marcellus shale drilling and brominated THMs in Pittsburgh, Pa., drinking water. Journal	Centralized Waste Treaters	17	No	Yes	CWT00490
5	EPA-HQ-OW-2015-0665-0960	Fourth Quarter 2000 Report for ASTF Grant #98-012. Project: Salmon as a Bioassay Model of Effects of Total Dissolved Solids DCN CWT00491	Fourth Quarter 2000 Report for ASTF Grant #98-012. Project: Salmon as a Bioassay Model of Effects of Total Dissolved Solids	Study	Stekoll, M., W. Smoker, I. Wang, and B. Fa	01/01/2001	Stekoll, M., W. Smoker, I. Wang, and B. Failor. 2001. Fourth Quarter 2000 Report for ASTF Grant #98-012. Project: Salmon as a Bioassay Model of Effects of Total Dissolved Solids. January 17	Centralized Waste Treaters	2	No	No	CWT00491
5	EPA-HQ-OW-2015-0665-0961	The influence of certain electrolytes on the induction of sperm motility in rainbow trout (Salmo gairdneri) DCN CWT00492	"Complementing earlier studies concerning the effect of the addition of different fluids to freshly collected trout milt (Holtz et al., 1977) the specific effect of certain minerals was investigated. Activation of spermatozoa normally occurring upon dilut	Publication; Copyrighted Material	Stoss, V.J., S. Buyukhatipoglu , and W. Hol	01/01/1977	Stoss, V.J., S. Buyukhatipoglu, and W. Holtz. 1977. The influence of certain electrolytes on the induction of sperm motility in rainbow trout (Salmo gairdneri). Zuchthyg 12:178-184	Centralized Waste Treaters	7	No	Yes	CWT00492

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5	EPA-HQ-OW-2015-0665-0937	Physical, chemical, and biological characteristics of compounds used in hydraulic fracturing DCN CWT00493	"Hydraulic fracturing (HF), a method to enhance oil and gas production, has become increasingly common throughout the U.S. As such, it is important to characterize the chemicals found in HF fluids to evaluate potential environmental fate, including fate i	Publication; Copyrighted Material	Stringfellow, W.T., J.K. Domen, M.K. Camar	04/25/2014	Stringfellow, W.T., J.K. Domen, M.K. Camarillo, W.L. Sandelin, and S. Borglin. 2014. Physical, chemical, and biological characteristics of compounds used in hydraulic fracturing. Journal of	Centralized Waste Treaters	18	No	Yes	CWT00493
5	EPA-HQ-OW-2015-0665-0936	Biodegradation in waters from hydraulic fracturing: chemistry, microbiology, and engineering DCN CWT00494	"This paper begins to address the microbial composition and aqueous chemistry and the potential for intrinsic and enhanced bioremediation of these waters. The waters from a gas and oil shale in the Marcellus and Bakken regions, respectively, were analyzed	Publication; Copyrighted Material	Strong, L., T. Gould, L. Kasinkas, M. Sado	01/01/2013	Strong, L., T. Gould, L. Kasinkas, M. Sadowsky, A. Aksan, and L. Wacektt. 2013. Biodegradation in waters from hydraulic fracturing: chemistry, microbiology, and engineering. J. Environ. Eng	Centralized Waste Treaters	9	No	Yes	CWT00494
5	EPA-HQ-OW-2015-0665-0935	Radium geochemistry of ground waters in Paleozoic carbonate aquifers, midcontinent, USA DCN CWT00495	"The purpose of this study was to elucidate the processes controlling the distribution and behavior of the longer-lived Ra isotopes in continuous Paleozoic carbonate aquifers of parts of Missouri, Kansas, and Oklahoma. Activities of (228Ra) and (226Ra) we	Publication; Copyrighted Material	Sturchio, N., J. Banner, C. Binz, L. Herat	12/03/1999	Sturchio, N., J. Banner, C. Binz, L. Heraty, and M. Musgrove. 2001. Radium geochemistry of ground waters in Paleozoic carbonate aquifers, midcontinent, USA. Applied Geochemistry 16:109-122	Centralized Waste Treaters	14	No	Yes	CWT00495

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5	EPA-HQ-OW-2015-0665-0934	Environmental Issues Surrounding Shale Gas Production. The U.S. Experience, a Primer. International Gas Union DCN CWT00496	"Shale gas development is receiving a great deal of public scrutiny and the debate over the environmental impact of this new technology has raised some genuinely important issues. Environmentalists claim the process could contaminate rivers and aquifers a	Report	Thorn, T.H	04/01/2012	Thorn, T.H. 2012. Environmental Issues Surrounding Shale Gas Production. The U.S. Experience, a Primer. Internatio nal Gas Union. April. Available: http://newgas.org .ua/sites/default/f	Centralized Waste Treaters	68	No	No	CWT00496
5	EPA-HQ-OW-2015-0665-0932	Major ion toxicity of six produced waters to three freshwater species: Application of ion toxicity models and TIE procedures DCN CWT00497	"Previous research to characterize the acute toxicity of major ions to freshwater organisms resulted in the development of statistical toxicity models for three freshwater species (Ceriodaphnia dubia, Pimephales promelas, and Daphnia magna). These ion tox	Publication; Copyrighted Material	Tietge, J.E., J.R. Hockett, and J.E. Evans	01/01/1997	Tietge, J.E., J.R. Hockett, and J.E. Evans. 1997. Major ion toxicity of six produced waters to three freshwater species: Application of ion toxicity models and TIE procedures. Environmental	Centralized Waste Treaters	7	No	Yes	CWT00497
5	EPA-HQ-OW-2015-0665-0930	Influence of saline drinking water on mineral balances in sheep DCN CWT00498	"The influence of sodium chloride ingestion via the drinking water upon the mineral balance in sheep has been examined. Four Merino ewes were offered rainwater containing zero, 0.8, or 1.3 % sodium chloride as the only source of drinking water. After corr	Publication	Tomas, F.M., G.B. Jones, B.J. Potter, and	01/01/1973	Tomas, F.M., G.B. Jones, B.J. Potter, and G.L. Langsford. 1973. Influence of saline drinking water on mineral balances in sheep. Aust J Agric Res 24:377–386.	Centralized Waste Treaters	10	No	Yes	CWT00498

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5	EPA-HQ-OW-2015-0665-0928	Salt in our streams: Even small sodium additions can have negative effects on detritivores DCN CWT00499	"We manipulated NaCl levels in microcosms containing just sweetgum (Liquidambar styraciflua L.) leaves with associated microbes, or leaves, microbes, and one of two macroinvertebrate detritivores (Tipula abdominalis Say in Experiment I and Lirceus sp. in	Publication; Copyrighted Material	Tyree, M., N. Clay, S. Polaskey, and S. En	03/04/2016	Tyree, M., N. Clay, S. Polaskey, and S. Entrekin. 2016. Salt in our streams: Even small sodium additions can have negative effects on detritivores. Hydrobiologia 775(1):109–122.	Centralized Waste Treaters	14	No	Yes	CWT00499
5	EPA-HQ-OW-2015-0665-0927	Radionuclides Rule: A Quick Reference Guide. EPA 816-F-01-003 DCN CWT00500	Document is reference guide for the EPA radionuclides rule 66 FR 76708 December 7, 2000 Vol. 65, No.226	Publication; USEPA	U.S. EPA	06/01/2001	U.S. EPA. 2001. Radionuclides Rule: A Quick Reference Guide. EPA 816-F-01-003. U.S. Environmental Protection Agency, Office of Water. June. Available: https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=3000	Centralized Waste Treaters	2	No	No	CWT00500
5	EPA-HQ-OW-2015-0665-0926	Radionuclides in Drinking Water. Reverse Osmosis DCN CWT00502	Website provides an overview of "reverse osmosis is a pressure-driven membrane separation process. Water is forced through a membrane with small pores by pressures ranging from 100 to 150 psi. Any molecules larger than the pore openings are excluded from	Publication; USEPA	U.S. EPA	01/01/2013	U.S. EPA. 2013. Radionuclides in Drinking Water. Reverse Osmosis. U.S. Environmental Protection Agency. Available: http://cfpub.epa.gov/safewater/radionuclides/radionuclides.cfm?action=Rad_Reverse%	Centralized Waste Treaters	3	No	No	CWT00502

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5	EPA-HQ-OW-2015-0665-0925	Environmental Assessment for the Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category. EPA-821-R-15-006 DCN CWT00503	"The U.S. Environmental Protection Agency (EPA) is promulgating revised effluent limitations guidelines and standards (ELGs) for the Steam Electric Power Generating Point Source Category (40 CFR 423). In support of the development of the final rule, EPA c	Publication; USEPA	U.S. EPA	09/01/2015	U.S. EPA. 2015a. Environmental Assessment for the Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category. EPA-821-R-15-006	Centralized Waste Treaters	513	No	No	CWT00503
5	EPA-HQ-OW-2015-0665-1059	Sources Contributing Inorganic Species to Drinking Water Intakes During Low Flow Conditions on the Alleghany River in Western Pennsylvania. EPA/600/R-14/430 DCN CWT00504	"This report, Sources Contributing Inorganic Species to Drinking Water Intakes during Low Flow Conditions on the Allegheny River in Western Pennsylvania, is the product of one of the research projects conducted as part of the EPA's study. It has undergone	Publication; USEPA	U.S. EPA	05/01/2015	U.S. EPA. 2015b. Sources Contributing Inorganic Species to Drinking Water Intakes During Low Flow Conditions on the Alleghany River in Western Pennsylvania. EPA/600/R-14/430	Centralized Waste Treaters	89	No	No	CWT00504
5	EPA-HQ-OW-2015-0665-0910	Hydraulic Fracturing for Oil and Gas: Impacts from the Hydraulic Fracturing Water Cycle on Drinking Water Resources in the United States. EPA-600-R-16-236ES. Executive Summary DCN CWT00505	"This final report provides a review and synthesis of available scientific information concerning the relationship between hydraulic fracturing activities and drinking water resources in the United States."	Publication; USEPA	U.S. EPA	12/01/2016	U.S. EPA. 2016a. Hydraulic Fracturing for Oil and Gas: Impacts from the Hydraulic Fracturing Water Cycle on Drinking Water Resources in the United States. EPA-600-R-16-236ES. Executive	Centralized Waste Treaters	666	No	No	CWT00505

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5		National Primary Drinking Water Standards DCN CWT00506	"EPA identifies contaminants to regulate in drinking water to protect public health. The Agency sets regulatory limits for the amounts of certain contaminants in water provided by public water systems. These contaminant standards are required by the Safe	Publication; USEPA	U.S. EPA	01/01/2016	U.S. EPA. 2016b. National Primary Drinking Water Standards. U.S. EPA, OW.	Centralized Waste Treaters	3	No	No	CWT00506
5	EPA-HQ-OW-2015-0665-0909	National Recommended Water Quality Criteria – Aquatic Life Criteria Table DCN CWT00508	"This table contains the most up to date criteria for aquatic life ambient water quality criteria. Aquatic life criteria for toxic chemicals are the highest concentration of specific pollutants or parameters in water that are not expected to pose a signi	Publication; USEPA	U.S. EPA	01/01/2017	U.S. EPA. 2017. National Recommended Water Quality Criteria – Aquatic Life Criteria Table. U.S. Environmental Protection Agency. Available: https://www.epa. gov/wqc/national	Centralized Waste Treaters	21	No	No	CWT00508
5	EPA-HQ-OW-2015-0665-0908	Water Quality Studied in Areas of Unconventional Oil and Gas Development, Including Areas where Hydraulic Fracturing Techniques are Used, in the United States. Fact Sheet DCN CWT00509	"The U.S. Geological Survey (USGS) John Wesley Powell Center for Analysis and Synthesis is hosting an interdisciplinary working group of USGS scientists to conduct a temporal and spatial analysis of surface-water and groundwater quality in areas of unconv	Publication; Other Governmental	USGS	04/01/2012	USGS. 2012 Water Quality Studied in Areas of Unconventional Oil and Gas Development, Including Areas where Hydraulic Fracturing Techniques are Used, in the United States. Fact Sheet 2012	Centralized Waste Treaters	4	No	No	CWT00509

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5	EPA-HQ-OW-2015-0665-0907	Impact of shale gas development on water resources: A case study in northern Poland DCN CWT00510	"In this study, we focussed on the potential impacts on regional water resources within the Baltic Basin in Poland, both in terms of quantity and quality. The future development of the shale play was modeled for the time period 2015–2030 using the LUISA m	Publication; Copyrighted Material	Vandecasteele , I., I.M. Rivero, S. Sala, C	04/16/2015	Vandecasteele, I., I.M. Rivero, S. Sala, C. Baranzelli, R. Barranco, O. Batelaan, and C. Lavalle. 2015. Impact of shale gas development on water resources: A case study in northern Poland. Environmental	Centralized Waste Treaters	15	No	Yes	CWT00510
5	EPA-HQ-OW-2015-0665-0906	A critical review of the risks to water resources from unconventional shale gas development and hydraulic fracturing in the United States DCN CWT00511	"This paper provides a critical review of the potential risks that shale gas operations pose to water resources, with an emphasis on case studies mostly from the U.S. Four potential risks for water resources are identified: (1) the contamination of shallo	Publication; Copyrighted Material	Vengosh, A., R.B. Jackson, N. Warner, T.H.	03/07/2014	Vengosh, A., R.B. Jackson, N. Warner, T.H. Darrah, and A. Kondash. 2014. A critical review of the risks to water resources from unconventional shale gas development and hydraulic fracturing in the	Centralized Waste Treaters	15	No	Yes	CWT00511
5	EPA-HQ-OW-2015-0665-0905	Impact of shale gas development on regional water quality DCN CWT00512	"Unconventional natural gas resources offer an opportunity to access a relatively clean fossil fuel that could potentially lead to energy independence for some countries. Horizontal drilling and hydraulic fracturing make the extraction of tightly bound na	Publication; Copyrighted Material	Vidic, R.D., S.L. Brantley, J.M. Vandenbos	05/17/2013	Vidic, R.D., S.L. Brantley, J.M. Vandenbossche, D. Yoxtheimer, and J.D. Abad. 2013. Impact of shale gas development on regional water quality. Science 340(6134), 1235009. Available: http://doi.org/10.1	Centralized Waste Treaters	11	No	Yes	CWT00512

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5	EPA-HQ-OW-2015-0665-0904	Assessing the risk associated with increasing bromide in drinking water sources in the Monongahela River, Pennsylvania DCN CWT00514	"This study presents a statistical simulation model to evaluate the effect of the increasing source-water bromide on THM formation and speciation and analyzes the changing risks (by using cancer slope factors) in treated water from 2010 to 2012. Even very	Publication; Copyrighted Material	Wang, Y., M.J. Small, and J.M. VanBriesen	10/31/2016	Wang, Y., M.J. Small, and J.M. VanBriesen. 2016. Assessing the risk associated with increasing bromide in drinking water sources in the Monongahela River, Pennsylvania. J. Environ. Eng	Centralized Waste Treaters	10	No	Yes	CWT00514
5	EPA-HQ-OW-2015-0665-0903	Scenario analysis of the impact on drinking water intakes from bromide in the discharge of treated oil and gas wastewater DCN CWT00516	This study used data from commercial wastewater treatment plants and river flow data in western Pennsylvania to construct generic discharge scenarios that illustrate the potential impacts from disposal of five classes of water that were developed from flo	Publication; Copyrighted Material	Weaver, J.S., J. Xu, and S.C. Mravik	08/13/2015	Weaver, J.S., J. Xu, and S.C. Mravik. 2016. Scenario analysis of the impact on drinking water intakes from bromide in the discharge of treated oil and gas wastewater. Journal of Environmental	Centralized Waste Treaters	14	No	Yes	CWT00516
5	EPA-HQ-OW-2015-0665-0902	Effects of total dissolved solids on aquatic organisms: A review of literature and recommendations for salmonid species DCN CWT00517	"Total dissolves solids (TDS) are naturally present in water or are the result of mining or some industrial treatment of water. TDS contain minerals and organic molecules that provide benefits such as nutrients or contaminants such as toxic metals and org	Publication; Copyrighted Material	Weber-Scannell, P. and L. Duffy	01/01/2007	Weber-Scannell, P. and L. Duffy. 2007. Effects of total dissolved solids on aquatic organisms: A review of literature and recommendation s for salmonid species. American Journal of Environmental	Centralized Waste Treaters	6	No	Yes	CWT00517

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5	EPA-HQ-OW-2015-0665-0901	Reactivity of natural organic matter with aqueous chlorine and bromine DCN CWT00518	"Experiments with model compounds and natural waters indicated more efficient substitution reactions with bromine than chlorine. Kinetic experiments with NOM isolates with and without pre-ozonation were conducted to obtain second-order rate constants (k)	Publication; Copyrighted Material	Westerhoff, P., P. Chao, and H. Mash	01/01/2004	Westerhoff, P., P. Chao, and H. Mash. 2004. Reactivity of natural organic matter with aqueous chlorine and bromine. Water Res. 38(6):1502–1513 .	Centralized Waste Treaters	12	No	Yes	CWT00518
5	EPA-HQ-OW-2015-0665-0900	Total dissolved solids in drinking-water DCN CWT00519	"Since the first edition of the WHO Guidelines for drinking-water quality GDWQ, WHO has published information on health criteria and other supporting information to the GDWQ, describing the approaches sed in deriving guideline values and presenting critic	Publication; Other Governmental	WHO	01/01/1996	WHO. 1996. Total dissolved solids in drinking-water. In Guidelines for Drinking-Water Quality, 2nd ed. Vol. 2. Health Criteria and Other Supporting Information. WHO/SDE/WSH/ 03.04/16. World	Centralized Waste Treaters	94	No	No	CWT00519
5	EPA-HQ-OW-2015-0665-0899	Sources of high total dissolved solids to drinking water supply in southwestern Pennsylvania DCN CWT00520	"Since the first edition of the WHO Guidelines for drinking-water qualit GDWQ, WHO has published information on health criteria and other supporting information to the GDWQ, describing the approaches sed in deriving guideline values and presenting critica	Publication; Copyrighted Material	Wilson, J., Y. Wang, and J. VanBriesen	05/11/2013	Wilson, J., Y. Wang, and J. VanBriesen. 2014. Sources of high total dissolved solids to drinking water supply in southwestern Pennsylvania. Journal of Environmental Engineering 140(5):1–10	Centralized Waste Treaters	11	No	Yes	CWT00520

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5	EPA-HQ-OW-2015-0665-0898	Oil and gas produced water management and surface drinking water sources in Pennsylvania DCN CWT00521	"The present study evaluates produced water management in Pennsylvania from 2006 through 2011 to determine whether surface water discharges were sufficient to cause salt or bromide loads that would negatively affect drinking water sources. The increase in	Publication; Copyrighted Material	Wilson, J.M. and J.M. VanBriesen	12/01/2012	Wilson, J.M. and J.M. VanBriesen. 2012. Oil and gas produced water management and surface drinking water sources in Pennsylvania. Environmental Practice 14(December):28	Centralized Waste Treaters	13	No	Yes	CWT00521
5	EPA-HQ-OW-2015-0665-0897	Treatment of hypersaline wastewater in the sequencing batch reactor DCN CWT00522	"In this paper, studies were conducted with a moderate halophile isolated from the Great Salt Lake, Utah, U.S.A. The organism was able to degrade phenol in a simulated oil field produced water containing 15% salt if iron, nitrogen and phosphorus were adde	Publication; Copyrighted Material	Woolard C.R. and R.L. Irvine	01/01/1995	Woolard C.R. and R.L. Irvine. 1995. Treatment of hypersaline wastewater in the sequencing batch reactor. Wat. Res. 29(4):1159–1168 .	Centralized Waste Treaters	10	No	Yes	CWT00522
5	EPA-HQ-OW-2015-0665-0896	Fate of radium in Marcellus Shale flowback water impoundments and assessment of associated health risks - DCN CWT00523	"The fate of Ra-226, which is the dominant NORM component in flowback water, in three centralized storage impoundments in southwestern Pennsylvania was investigated during a 2.5-year period. Field sampling revealed that Ra-226 concentration in these stora	Publication; Copyrighted Material	Zhang, T., R.W. Hammack, and R.D. Vidic	01/01/2015	Zhang, T., R.W. Hammack, and R.D. Vidic. 2015. Fate of radium in Marcellus Shale flowback water impoundments and assessment of associated health risks. Environ. Sci. Technol. 49(15):9347–935 4	Centralized Waste Treaters	8	No	Yes	CWT00523

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5	EPA-HQ-OW-2015-0665-0895	Desalinization of running waters III. Changes in the structure of diatom assemblages caused by a decreasing salt load and changing ion spectra in the river Wipper (Thuringia, Germany) - DCN CWT00524	"An ecological assessment of the changes was performed based on the halobion index calculated from all the samples. For the strongly salinized section of the river Wipper, a shift from α-mesohalobic/polyhalobic conditions in 1963/64 and 1986 to α-oligohal	Publication; Copyrighted Material	Ziemann, H., L. Kies, and C.-J. Schulz	01/28/2001	Ziemann, H., L. Kies, and C.-J. Schulz. 2001. Desalinization of running waters III. Changes in the structure of diatom assemblages caused by a decreasing salt load and changing ion spectra in the	Centralized Waste Treaters	0	No	Yes	CWT00524
5	EPA-HQ-OW-2015-0665-0894	Final Report – Water Quality Literature Review and Field Monitoring of Active Shale Gas Wells. Phase I for "Assessing Environmental Impacts of Horizontal Gas Well Drilling Operations DCN CWT00525	"This report summarizes the results of the phase II portion of the study, Water Quality Literature Review and Field Monitoring of Active Shale Gas Wells. Phase II consisted of: 1) hydrogeological testing and monitoring of the perimeter groundwater monitor	Study	Ziemkiewicz, P., J. Hause, B. Gutta, J. Fi	02/15/2013	Ziemkiewicz, P., J. Hause, B. Gutta, J. Fillhart, B. Mack, and M. O'Neal. 2013. Final Report – Water Quality Literature Review and Field Monitoring of Active Shale Gas Wells. Phase I for "Assessing	Centralized Waste Treaters	141	No	No	CWT00525
5	EPA-HQ-OW-2015-0665-0893	Characterization of liquid waste streams from shale gas development - DCN CWT00526	"In order to better understand risks associated with shale gas development, the West Virginia Legislature in May 2012 requested the West Virginia University Water Research Institute to investigate the health implications of liquid wastes related to horizo	Publication; Copyrighted Material	Ziemkiewicz, P.F	01/01/2013	Ziemkiewicz, P.F. 2013. Characterization of liquid waste streams from shale gas development. AGH Drilling, Oil, Gas 30(1):297–309.	Centralized Waste Treaters	13	No	Yes	CWT00526

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5	EPA-HQ-OW-2015-0665-0892	Salinisation of inland waters - DCN CWT00527	"Salinisation is caused by natural factors (e.g. the soil types of catchment areas, atmospheric deposition and climate) and by anthropogenic activities (e.g. agriculture and mining). Some of the consequences are an increase of salt content, and the enrich	Publication; Copyrighted Material	Zimmermann-Timm, H	01/01/2007	Zimmermann-Timm, H. 2007. Salinisation of inland waters. In Water Uses and Human Impacts on the Water Budget, J. Lozan, H. Graßl, P. Hupfer, L. Menzel, and C. Schönwiese (eds.). Verlag Wissenschaftlich	Centralized Waste Treaters	4	No	Yes	CWT00527
5.0	EPA-HQ-OW-2015-0665-0651	Impacts of Shale Gas Wastewater Disposal on Water Quality in Western Pennsylvania - DCN CWT00360	This paper examines water quality and isotopic compositions of discharged effluents, surface waters, and stream sediments associated with treatment facilities in western Pennsylvania.	Publication; Copyrighted Material	Warner, Nathaniel; Cidney, Christie; Jacks	09/10/2013	Warner et al. 2013. Impacts of Shale Gas Wastewater Disposal on Water Quality in Western PA. Environmental Science & Technology 47(20):11849–11857	Centralized Waste Treaters	9	No	Yes	CWT00360
5.0	EPA-HQ-OW-2015-0665-0749	Draft Summary of Total Dissolved Solids Impacts to Water Quality Uses. Memorandum to T. Born (EPA) dated April 10. DCN CWT00408	"The United States Environmental Protection Agency (EPA) is considering regulating shale gas extraction (SGE) under the Clean Water Act (CWA) to reduce pollutant loads and discharges resulting from production of SGE wastewaters.1 Waters with excessive tot	Memorandum	Abt Associates	04/10/2013	Abt Associates. 2013. Draft Summary of Total Dissolved Solids Impacts to Water Quality Uses. Memorandum to T. Born (EPA) dated April 10. Abt Associates, Cambridge, MA.	Centralized Waste Treaters	13	No	No	CWT00408

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5.0	EPA-HQ-OW-2015-0665-0750	Draft Environmental Assessment Literature Review for Centralized Waste Treatment (CWT) Detailed Study. Memorandum to T. Born (EPA) dated June 20. DCN CWT00409	"Abt Associates ("Abt") conducted an Environmental Assessment Literature Review ("literature review") to aid EPA in assessing potential surface water impacts of oil and gas wastewater treated and discharged by CWTs. Abt researched and obtained relevant av	Memorandum	Abt Associates	06/20/2015	Abt Associates. 2015. Draft Environmental Assessment Literature Review for Centralized Waste Treatment (CWT) Detailed Study. Memorandum to T. Born (EPA) dated June 20	Centralized Waste Treaters	25	No	No	CWT00409
5.0	EPA-HQ-OW-2015-0665-0751	Final Memorandum for CWT Discharge Environmental Data Collection - Task 8.2: Residuals. [Work Assignment No. 2-06; Amendment 2, EPA Contract No. EP-C-13-039]. Memorandum to K. Milam, E. Trentacoste, and J. Pritts, U.S. EPA, dated July 21. DCN CWT00410	This memorandum provides information on the levels of radionuclides and/or radioactivity reported in effluent discharged from CWT facilities accepting O&G wastes, as available from Discharge Monitoring Reports (DMRs). These levels are to be evaluated rega	Memorandum	Abt Associates	07/20/2016	Abt Associates. 2016. Final Memorandum for CWT Discharge Environmental Data Collection - Task 8.2: Residuals. [Work Assignment No. 2-06; Amendment 2, EPA Contract	Centralized Waste Treaters	12	No	No	CWT00410
5.0	EPA-HQ-OW-2015-0665-0848	Irrigation Water Quality Standards and Salinity Management Strategies. B-1667 4-03. DCN CWT00411	Document provides a summary of irrigation water quality standards and salinity management strategies focused superficially on Texas agricultural lands.	Guidance, Interpretation, Policy, Procedure	AgriLife Extension	05/08/2003	AgriLife Extension. 2003. Irrigation Water Quality Standards and Salinity Management Strategies. B-1667 4-03. Texas A&M System, College Station, TX. May 8. Available: http://oaktrust.libr	Centralized Waste Treaters	17	No	No	CWT00411

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5.0	EPA-HQ-OW-2015-0665-0856	Organic and inorganic composition and microbiology of produced waters from Pennsylvania shale gas wells. DCN CWT00412	"The presence of culturable bacteria was not associated with salinity or location; although organic compound concentrations and time in production were correlated with microbial activity. Interestingly, we found that unlike the inorganic chemistry, PW org	Publication; Copyrighted Material	Akob, D.M., I.M. Cozzarelli, D.S. Dunlap,	01/01/2015	Akob, D.M., I.M. Cozzarelli, D.S. Dunlap, E.L. Rowan, and M.M. Lorah. 2015. Organic and inorganic composition and microbiology of produced waters from Pennsylvania shale gas wells. Applied	Centralized Waste Treaters	10	No	Yes	CWT00412
5.0	EPA-HQ-OW-2015-0665-0849	Treatment of shale gas produced water for discharge. Presentation at the NETL/DOE Technical Workshops for the Hydraulic Fracturing Study DCN CWT00413	Document is a presentation of produced water management strategies, goals, challenges, and other considerations.	Meeting or Teleconference Materials	Alleman, D	03/01/2011	Alleman, D. 2011. Treatment of shale gas produced water for discharge. Presentation at the NETL/DOE Technical Workshops for the Hydraulic Fracturing Study. March 2011. Available electronically at:	Centralized Waste Treaters	26	No	No	CWT00413
5.0	EPA-HQ-OW-2015-0665-0850	Australian and New Zealand Guidelines for Fresh and Marine Water Quality DCN CWT00414	"The Australian and New Zealand Guidelines for Fresh and Marine Water Quality (the Guidelines) have been prepared as part of Australia's National Water Quality Management Strategy (NWQMS) and relate to New Zealand's National Agenda for Sustainable Water	Guidance, Interpretation, Policy, Procedure	Anzecc, A	10/01/2000	Anzecc, A. 2000. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australia n and New Zealand Environment and Conservation Council and	Centralized Waste Treaters	3	No	No	CWT00414

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5.0	EPA-HQ-OW-2015-0665-0851	A Comprehensive Ichthyofaunal Survey of Tenmile Creek Watershed: Phase II. Final Report for Grant Agreement WRCP-07283 DCN CWT00415	"This project is a continuation of the survey of Tenmile Creek drainage initiated as "A Comprehensive Ichthyofaunal Survey of the Tenmile Creek Watershed" (Phase I - Grant Agreement WRCP-06169), extending upstream from Station 15 – approximately 16 km to	Report	Argent, D.G. and W.G. Kimmel	01/01/2009	Argent, D.G. and W.G. Kimmel. 2009. A Comprehensive Ichthyofaunal Survey of Tenmile Creek Watershed: Phase II. Final Report for Grant Agreement WRCP-07283. California University of PA	Centralized Waste Treaters	18	No	No	CWT00415
5.0	EPA-HQ-OW-2015-0665-0852	Water Quality for Irrigated Agriculture – Salinity/Sodicity Focus DCN CWT00416	Document is a presentation on salinity and sodicity in water for agricultural irrigation. The presentation includes descriptions of irrigation water quality management and yield impacts of degraded water quality.	Report	Bauder, T., J. Stednick, T. Gates, and L.		Bauder, T., J. Stednick, T. Gates, and L. Sutherland. Undated. Water Quality for Irrigated Agriculture – Salinity/Sodicity Focus. Colorado State University and the Natural Resources Conservation	Centralized Waste Treaters	47	No	No	CWT00416
5.0	EPA-HQ-OW-2015-0665-0853	Hydraulic Fracturing Radiological Concerns for Ohio. Fact Sheet prepared for FreshWater Accountability Project Ohio DCN CWT00417	"In this fact sheet, we want to cut through this murky haze that is settling over Ohio. We will explore the situation at the Patriot water treatment plant in Warren, OH, solid waste disposal in landfills, the potential impact of fracking near public drink	Fact/Data Sheet	Belcher, M. and M. Resnikoff	06/13/2013	Belcher, M. and M. Resnikoff. 2013. Hydraulic Fracturing Radiological Concerns for Ohio. Fact Sheet prepared for FreshWater Accountability Project Ohio. Radioactive Waste Management	Centralized Waste Treaters	37	No	No	CWT00417

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5.0	EPA-HQ-OW-2015-0665-0854	Marcellus Shale Post-Frac Flowback Waters – Where Is All the Salt Coming from and What Are the Implications? Paper SPE 125740 DCN CWT00418	"In this paper, we present both geochemical and lithologic laboratory and field data to address the salt question. Is salt being dissolved from the shale, or are deep saline aquifers being breached during hydraulic fracturing? What evidence do we have to	Publication; Copyrighted Material	Blauch, M.E., R.R. Myers, T.R. Moore, B.A.	09/23/2009	Blauch, M.E., R.R. Myers, T.R. Moore, B.A. Lipinski, and N.A. Houston. 2009. Marcellus Shale Post-Frac Flowback Waters – Where Is All the Salt Coming from and What Are the Implications? Paper SPE	Centralized Waste Treaters	20	No	Yes	CWT00418
5.0	EPA-HQ-OW-2015-0665-0855	Radionuclides in fracking wastewater: Managing a toxic blend DCN CWT00419	Document discusses issues surrounding the occurrence of radionuclides in fracking wastewater with a focus on produced water in the Marcellus Shale region of Pennsylvania.	Publication; Copyrighted Material	Brown, V.J	02/01/2014	Brown, V.J. 2014. Radionuclides in fracking wastewater: Managing a toxic blend. Environmental Health Perspectives 122:A50–A55. Available: http://doi.org/10.1289/ehp.122	Centralized Waste Treaters	6	No	Yes	CWT00419
5.0	EPA-HQ-OW-2015-0665-0857	Taste quality of mineralized water DCN CWT00420	"The purpose of the present report is to present results from two taste panel studies in which panel members rated the general taste quality of natural water samples. The panel data, along with results from consumer surveys which will be reported separate	Publication; Copyrighted Material	Bruvold, W.H. and H.J. Ongerth	05/01/1969	Bruvold, W.H. and H.J. Ongerth, 1969. Taste quality of mineralized water. Journal of the American Water Works Association 61(4):170–174.	Centralized Waste Treaters	6	No	Yes	CWT00420

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5.0	EPA-HQ-OW-2015-0665-0858	Organic pollutants in shale gas flowback and produced waters: Identification, potential ecological impact, and implications for treatment strategies DCN CWT00421	"This review addresses identification of individual organic contaminants in FPW, and stresses the gaps in the knowledge on FPW composition that exist so far. Furthermore, the risk quotient approach was applied to predict the toxicity of the quantified org	Publication; Copyrighted Material	Butkovskyi, A., H. Bruning, S.A.E. Kools,	04/05/2017	Butkovskyi, A., H. Bruning, S.A.E. Kools, H.H.M. Rijnaarts, and A.P. Van Wezel. 2017. Organic pollutants in shale gas flowback and produced waters: Identification, potential	Centralized Waste Treaters	15	No	Yes	CWT00421
5.0	EPA-HQ-OW-2015-0665-0859	Salinisation of rivers: An urgent ecological issue DCN CWT00422	"Secondary salinisation of rivers and streams is a global and growing threat that might be amplified by climate change. It can have many different causes, like irrigation, mining activity or the use of salts as de-icing agents for roads. Freshwater organi	Publication; Copyrighted Material	Cañedo-Argüelles, M., B.J. Kefford, C. Pis	10/10/2012	Cañedo-Argüelles, M., B.J. Kefford, C. Piscart, N. Prat, R.B. Schäfer, and C. Schulz. 2013. Salinisation of rivers: An urgent ecological issue. Environ. Pollut. 173:157–167.	Centralized Waste Treaters	11	No	Yes	CWT00422
5.0	EPA-HQ-OW-2015-0665-0860	Inhibition of anaerobic digestion process: A review DCN CWT00423	"This review provides a detailed summary of the research conducted on the inhibition of anaerobic processes. The inhibitors commonly present in anaerobic digesters include ammonia, sulfide, light metal ions, heavy metals, and organics. Due to the differen	Publication; Copyrighted Material	Chen, Y., J.J. Cheng, and K.S. Creamer	01/25/2007	Chen, Y., J.J. Cheng, and K.S. Creamer. 2008. Inhibition of anaerobic digestion process: A review. Bioresource Technology 99:4044–4064. Available: http://www.zjubiolab.zju.edu.cn/wu	Centralized Waste Treaters	21	No	Yes	CWT00423

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5.0	EPA-HQ-OW-2015-0665-0958	Temporal changes in microbial ecology and geochemistry in produced water from hydraulically fractured Marcellus shale gas wells DCN CWT00425	"This study tracked microbial community dynamics using pyrotag sequencing of 16S rRNA genes in water samples from three hydraulically fractured Marcellus shale wells in Pennsylvania, USA over a 328-day period. There was a reduction in microbial richness a	Publication; Copyrighted Material	Cluff, M.A., A. Hartsock, J.D. MacRae, K.	01/01/2014	Cluff, M.A., A. Hartsock, J.D. MacRae, K. Carter, and P.J. Mouser. 2014. Temporal changes in microbial ecology and geochemistry in produced water from hydraulically fractured	Centralized Waste Treaters	10	No	Yes	CWT00425
5.0	EPA-HQ-OW-2015-0665-0866	Natural gas operations from a public health perspective DCN CWT00426	"The discussion highlights the difficulty of developing effective water quality monitoring programs. To protect public health we recommend full disclosure of the contents of all products, extensive air and water monitoring, coordinated environmental/human	Publication; Copyrighted Material	Colborn, T., C. Kwiatkowski, K. Schultz, a	09/20/2011	Colborn, T., C. Kwiatkowski, K. Schultz, and M. Bachran. 2011. Natural gas operations from a public health perspective. Human and Ecological Risk Assessment 17:1039–1056.	Centralized Waste Treaters	19	No	Yes	CWT00426
5.0	EPA-HQ-OW-2015-0665-0867	Implementing Narrative Standards in Discharge Permits for the Protection of Irrigated Crops. Colorado Department of Public Health & Environment, Colorado Water Quality Control Division. Policy #WQP-24. March 8. DCN CWT00427	"The purpose of this policy is to provide additional guidance to the development of effluent limits, under two narrative standards, for permitting discharges to surface waters that subsequently are diverted to crop irrigation. The scope of this guidance i	Publication; Other Governmental	Colorado Department of Public Health & Env	03/08/2008	Colorado Department of Public Health & Environment. 2008. Implementing Narrative Standards in Discharge Permits for the Protection of Irrigated Crops. Colorado Department of	Centralized Waste Treaters	34	No	No	CWT00427

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5.0	EPA-HQ-OW-2015-0665-0868	Water Quality Permits – Policies & Procedures. Implementing Narrative Standards in Discharge Permits for the Protection of Irrigated Crops. Policy #: WQP-24 DCN CWT00428	"The purpose of this policy is to provide additional guidance to the development of effluent limits, under two narrative standards, for permitting discharges to surface waters that subsequently are diverted to crop irrigation. The scope of this guidance i	Guidance, Interpretation, Policy, Procedure	Colorado WQCD	03/08/2018	Colorado WQCD. 2008. Water Quality Permits – Policies & Procedures. Implementing Narrative Standards in Discharge Permits for the Protection of Irrigated Crops. Policy #:	Centralized Waste Treaters	34	No	No	CWT00428
5.0	EPA-HQ-OW-2015-0665-0869	A Review of the Rationale for EC and SAR Standards. WQPBWQSTR-002 DCN CWT00429	"On April 15, 2010, the Board of Environmental Review (Board) gave notice of its intent to review Montana's water quality standards through the triennial review process, as required by the federal Clean Water Act, 33 U.S.C. § 1313 (c). Included in this re	Publication; Other Governmental	Compton, A	08/05/2011	Compton, A. 2011. A Review of the Rationale for EC and SAR Standards. WQPBWQSTR-002. Montana Department of Environmental Quality, Water Quality Planning Bureau, Helena. August 5. Available	Centralized Waste Treaters	44	No	No	CWT00429
5.0	EPA-HQ-OW-2015-0665-0870	A fresh look at road salt: Aquatic toxicity and water-quality impacts on local, regional, and national scales DCN CWT00430	"A new perspective on the severity of aquatic toxicity impact of road salt was gained by a focused research effort directed at winter runoff periods. Dramatic impacts were observed on local, regional, and national scales. Locally, samples from 7 of 13 Mil	Publication; Copyrighted Material	Corsi, S.R., D.J. Graczyk, S.W. Geis, N.L.	07/22/2010	Corsi, S.R., D.J. Graczyk, S.W. Geis, N.L. Booth, and K.D. Richards. 2010. A fresh look at road salt: Aquatic toxicity and water-quality impacts on local, regional, and national scales. Environmental	Centralized Waste Treaters	7	No	Yes	CWT00430

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5.0	EPA-HQ-OW-2015-0665-0871	Biological Treatment of High Salinity Wastewater Using Yeast and Bacterial Systems DCN CWT00431	"This study aimed to compare the performance of aerobic treatment using wild mixed yeast and bacterial culture for high salinity wastewater. The operating conditions of yeast treatment under high salinity such as pH, sludge retention time (SRT) and dissol	Study	Dan, N.P	12/01/2001	Dan, N.P. 2001. Biological Treatment of High Salinity Wastewater Using Yeast and Bacterial Systems. PhD Thesis, Asian Institute of Technology, Bangkok, Thailand. Available	Centralized Waste Treaters	170	No	No	CWT00431
5.0	EPA-HQ-OW-2015-0665-0872	Influence of high NaCl and NH4Cl salt levels on methanogenic associations DCN CWT00432	"The effect of high levels of NaCl and NH4Cl on the activity and attachment of methanogenic associations in semi-continuous flow-through reactor systems has been evaluated. Two well-functioning reactors received shock concentrations of NaCl and NH4Cl whil	Publication; Copyrighted Material	de Baere, L.A., M. Devocht, P. Van Assche,	01/01/1984	de Baere, L.A., M. Devocht, P. Van Assche, and W. Verstraete. 1984. Influence of high NaCl and NH4Cl salt levels on methanogenic associations. Water Research 18(5):543–548.	Centralized Waste Treaters	6	No	Yes	CWT00432
5.0	EPA-HQ-OW-2015-0665-0873	A comparison of zooplankton communities in saline lakewater with variable anion composition DCN CWT00433	"In this study, zooplankton species were related to environmental variables from 12 lakes: three saline lakes with water where the dominant anions were SO4 and CO3, four saline lakes with Cl-dominated water, and five dilute, subsaline (0.5–3 gl−1 total di	Publication; Copyrighted Material	Derry, A.M., E.E. Prepas, and P.D.N. Heber	05/23/2003	Derry, A.M., E.E. Prepas, and P.D.N. Hebert, 2003. A comparison of zooplankton communities in saline lakewater with variable anion composition. Hydrobiologia 505:199–215.	Centralized Waste Treaters	17	No	Yes	CWT00433

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5.0	EPA-HQ-OW-2015-0665-0874	Chemistry and Origin of Oil and Gas Well Brines in Western Pennsylvania. Open-File Report OFOG 10–01 DCN CWT00434	"Brines having moderate to high salt content (up to 343 grams per liter [g/L]) occupy most pore spaces in rocks below a depth of a few thousand feet in Pennsylvania and are brought to the surface during oil and gas operations. Forty analyses of brines fro	Publication; Other Governmental	Dresel, P.E. and A.W. Rose	01/01/2010	Dresel, P.E. and A.W. Rose. 2010. Chemistry and Origin of Oil and Gas Well Brines in Western Pennsylvania. Open-File Report OFOG 10–01. Pennsylvania Geol. Surv., 4th ser	Centralized Waste Treaters	56	No	No	CWT00434
5.0	EPA-HQ-OW-2015-0665-0875	Contribution of brominated organic disinfection by-products to the mutagenicity of drinking water DCN CWT00435	"The activity inducing chromosomal aberrations of the mixture of brominated disinfection by-products (DBPs) was approximately three times higher than that of the chlorinated counterparts for the same hypohalous acid dose. With the combination of chromosom	Publication; Copyrighted Material	Echigo, S., S. Itoh, T. Natsui, T. Araki,	01/01/2004	Echigo, S., S. Itoh, T. Natsui, T. Araki, and R. Ando. 2004. Contribution of brominated organic disinfection by-products to the mutagenicity of drinking water. Water Science Technology 50(5):321–328	Centralized Waste Treaters	8	No	Yes	CWT00435
5.0	EPA-HQ-OW-2015-0665-0876	A systematic evaluation of chemicals in hydraulic-fracturing fluids and wastewater for reproductive and developmental toxicity DCN CWT00436	"We systematically evaluated 1021 chemicals identified in hydraulic-fracturing fluids (n=925), wastewater (n=132), or both (n=36) for potential reproductive and developmental toxicity to triage those with potential for human health impact. We searched the	Publication; Copyrighted Material	Elliott, E.G., A.S. Ettinger, B.P. Leadere	09/25/2015	Elliott, E.G., A.S. Ettinger, B.P. Leaderer, M.B. Bracken, and N.C. Deziel. 2017. A systematic evaluation of chemicals in hydraulic-fracturing fluids and wastewater for reproductive and	Centralized Waste Treaters	10	No	Yes	CWT00436

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5.0	EPA-HQ-OW-2015-0665-0877	Stream vulnerability to widespread and emergent stressors: A focus on unconventional oil and gas DCN CWT00437	"We developed indices to describe the watershed sensitivity and exposure to natural and anthropogenic disturbances and computed a vulnerability index from these two scores across stream catchments in six productive shale plays. We predicted that catchment	Publication; Copyrighted Material	Entrekin, S.A., K.O. Maloney, K.E. Kapo, A	09/23/2015	Entrekin, S.A., K.O. Maloney, K.E. Kapo, A.W. Walters, M.A. Evans-White, and K.M. Klemow. 2015. Stream vulnerability to widespread and emergent stressors: A focus on unconventional	Centralized Waste Treaters	28	No	Yes	CWT00437
5.0	EPA-HQ-OW-2015-0665-0959	Effects of Total Dissolved Solids (TDS) on Fertilization and Viability of Rainbow Trout and Chum Salmon Embryos. Revised Final Draft. EVS Project No. 9/302-28. DCN CWT00440	Effects of Total Dissolved Solids (TDS) on Fertilization and Viability of Rainbow Trout and Chum Salmon Embryos	Study	EVS Environment Consultants	01/01/1998	EVS Environment Consultants. 1998. Effects of Total Dissolved Solids (TDS) on Fertilization and Viability of Rainbow Trout and Chum Salmon Embryos. Revised Final Draft. EVS	Centralized Waste Treaters	1	No	No	CWT00440
5.0	EPA-HQ-OW-2015-0665-0879	WVDEP Permit Determination Form; Permit R13-2794. DCN CWT00441	Permit document from the West Virginia Department of Environmental Protection for Fairmont Brine Processing, LLC	Permit, Registration	Joe Kessler	08/24/2016	FBP. 2016. WVDEP Permit Determination Form; Permit R13-2794. Fairmont Brine Processing LLC, Fairmont, WV. Available electronically at: https://dep.wv.gov/daq/Documents/August%202016%20Permits%20	Centralized Waste Treaters	20	No	No	CWT00441

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5.0	EPA-HQ-OW-2015-0665-0880	Sodium inhibition in the anaerobic digestion process: Antagonism and adaptation phenomena DCN CWT00442	"The effect of sodium on the methanization of volatile fatty acid (VFA) mixtures was evaluated for three different sludges. Sodium concentrations causing 50% inhibition ranged from 3 to 16 g l−1 in the absence of nutrients or other salts, showing a higher	Publication; Copyrighted Material	Feijoo, G., M. Soto, R. Méndez, and J.M. L	01/01/1995	Feijoo, G., M. Soto, R. Méndez, and J.M. Lema. 1995. Sodium inhibition in the anaerobic digestion process: Antagonism and adaptation phenomena. Enzyme and Microbial	Centralized Waste Treaters	9	No	Yes	CWT00442
5.0	EPA-HQ-OW-2015-0665-0881	Assessment of effluent contaminants from three facilities discharging Marcellus shale wastewater to surface waters in Pennsylvania DCN CWT00443	"Unconventional natural gas development in Pennsylvania has created a new wastewater stream. In an effort to stop the discharge of Marcellus Shale unconventional natural gas development wastewaters into surface waters, on May 19, 2011 the Pennsylvania Dep	Publication; Copyrighted Material	Ferrar, K.J., D.R. Michanowicz, C.L. Chris	05/04/2013	Ferrar, K.J., D.R. Michanowicz, C.L. Christen, N. Mulcahy, S.L. Malone, and R.K. Sharma. 2013. Assessment of effluent contaminants from three facilities discharging	Centralized Waste Treaters	10	No	Yes	CWT00443
5.0	EPA-HQ-OW-2015-0665-0882	Influence of oil and gas field operations on spatial and temporal distributions of atmospheric non-methane hydrocarbons and their effect on ozone formation in winter DCN CWT00444	"Emissions from oil and natural gas development during winter in the Upper Green River basin of Wyoming are known to drive episodic ozone (O3) production. Contrasting O3 distributions were observed in the winters of 2011 and 2012, with numerous episodes (	Publication; Copyrighted Material	Field, R.A., J. Soltis, M.C. McCarthy, S.	03/31/2015	Field, R.A., J. Soltis, M.C. McCarthy, S. Murphy, and D.C. Montague. 2015. Influence of oil and gas field operations on spatial and temporal distributions of atmospheric non-methane hydrocarbons	Centralized Waste Treaters	16	No	Yes	CWT00444

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5.0	EPA-HQ-OW-2015-0665-0883	Fracked ecology: Response of aquatic trophic structure and mercury biomagnification dynamics in the Marcellus Shale formation DCN CWT00445	"Twenty-seven remotely-located streams in Pennsylvania's Marcellus Shale basin were sampled during June and July of 2012 and 2013. At each stream, stream physiochemical properties, trophic biodiversity, and structure and mercury levels were assessed. We u	Publication; Copyrighted Material	Grant, C.J., A.K. Lutz, A.D. Kulig, and M.	10/14/2016	Grant, C.J., A.K. Lutz, A.D. Kulig, and M.R. Stanton. 2016. Fracked ecology: Response of aquatic trophic structure and mercury biomagnification dynamics in the Marcellus Shale formation	Centralized Waste Treaters	12	No	Yes	CWT00445
5.0	EPA-HQ-OW-2015-0665-0884	Detailed Study of Irrigation Drainage in and near Wildlife Management Areas, West-Central Nevada, 1987-90. Part B. Effect on Biota in Stillwater and Fernley Wildlife Management Areas and other Nearby Wetlands DCN CWT00446	A water-quality reconnaissance study during 1986-87 found high concentrations of several potentially toxic elements in water, bottom sediment, and biota in and near Stillwater Wildlife Management Area (WMA). This study prompted the U.S. Department of the	Publication; Other Governmental	Hallock, R.J. and L.L. Hallock (eds.)	01/01/1993	Hallock, R.J. and L.L. Hallock (eds.). 1993. Detailed Study of Irrigation Drainage in and near Wildlife Management Areas, West-Central Nevada, 1987-90. Part B. Effect on Biota in Stillwater and Fernley Wildlife	Centralized Waste Treaters	86	No	No	CWT00446
5.0	EPA-HQ-OW-2015-0665-0885	Lethal levels of sodium chloride and potassium chloride for an oligochaete, chironomid, and a caddisfly of Lake Michigan DCN CWT00448	"Three species of aquatic invertebrates, sampled at sites in Lake Michigan, were subjected in the laboratory to known sodium chloride and potassium chloride concentrations in aqueous solutions. Lethal levels for each organism were observed and recorded fo	Publication; Copyrighted Material	Hamilton, R.W., J.K. Butter, and R.G. Brun	01/01/1975	Hamilton, R.W., J.K. Butter, and R.G. Brunette. 1975. Lethal levels of sodium chloride and potassium chloride for an oligochaete, chironomid, and a caddisfly of Lake Michigan. Environmental Entomology	Centralized Waste Treaters	4	No	Yes	CWT00448

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5.0	EPA-HQ-OW-2015-0665-0886	Transport, Storage, and Disposal of Fracking Waste. Research Report 2014-R-0016 DCN CWT00449	"The transportation, storage, and disposal of hydraulic fracturing ("fracking") waste are regulated under a variety of federal and state laws. Contaminated water, which is fracking's largest waste product, is typically (1) treated to remove contaminants a	Report	Hansen, L.R	01/14/2014	Hansen, L.R. 2014. Transport, Storage, and Disposal of Fracking Waste. Research Report 2014-R-0016. Connecticut General Assembly, Office of Legislative Research, Hartford, CT	Centralized Waste Treaters	14	No	No	CWT00449
5.0	EPA-HQ-OW-2015-0665-0887	Discharges of produced waters from oil and gas extraction via wastewater treatment plants are sources of disinfection by-products to receiving streams DCN CWT00451	"To determine if wastewater treatment plants that accept produced waters discharge greater amounts of brominated DBPs, water samples were collected in Pennsylvania from four sites along a large river including an upstream site, a site below a publicly own	Publication; Copyrighted Material	Hladik, M.L., M.J. Focazio, and M. Engle	08/29/2013	Hladik, M.L., M.J. Focazio, and M. Engle. 2014. Discharges of produced waters from oil and gas extraction via wastewater treatment plants are sources of disinfection by-products to receiving	Centralized Waste Treaters	9	No	Yes	CWT00451
5.0	EPA-HQ-OW-2015-0665-0888	Bicarbonate as a potential confounding factor in cladoceran toxicity assessments of pore water from contaminated sediments DCN CWT00452	"Elevated alkalinity values measured in sediment pore water samples from the Grand Calumet River–Indiana Harbor Canal, an International joint Commission Area of Concern (AOC), caused concern over the potential effects of alkalinity on cladoceran test resp	Publication; Copyrighted Material	Hoke, R.A., W.R. Gala, J.B. Drake, J.P. Ge	02/26/1992	Hoke, R.A., W.R. Gala, J.B. Drake, J.P. Geisy, and S. Fleger. 1992. Bicarbonate as a potential confounding factor in cladoceran toxicity assessments of pore water from contaminated	Centralized Waste Treaters	8	No	Yes	CWT00452

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5.0	EPA-HQ-OW-2015-0665-0889	Elevated major ion concentrations inhibit larval mayfly growth and development DCN CWT00453	"Anthropogenic disturbances, including those from developing energy resources, can alter stream chemistry significantly by elevating total dissolved solids. Field studies have indicated that mayflies (Order Ephemeroptera) are particularly sensitive to hig	Publication; Copyrighted Material	Johnson, B.R., P.C. Weaver, C.T. Nietch, J	10/08/2014	Johnson, B.R., P.C. Weaver, C.T. Nietch, J.M. Lazorchak, K.A. Struewing, and D.H. Funk. 2014. Elevated major ion concentrations inhibit larval mayfly growth and development. Environmental	Centralized Waste Treaters	6	No	Yes	CWT00453
5.0	EPA-HQ-OW-2015-0665-0911	Effect of salt concentration on biological treatment of saline wastewater by fed-batch operation DCN CWT00454	"The performance of biological treatment processes for saline wastewater is usually low due to adverse effects of salt on microbial flora. High salt concentrations in wastewater cause plasmolysis and loss of cell activity, thereby resulting in low (COD) r	Publication; Copyrighted Material	Kargi, F. and A.R. Dincer	01/01/1996	1996. Effect of salt concentration on biological treatment of saline wastewater by fed-batch OP. Enzyme & Microbial Tech 19(7):529–537.	Centralized Waste Treaters	9	No	Yes	CWT00454
5.0	EPA-HQ-OW-2015-0665-0912	Saline wastewater treatment by halophile-supplemented activated sludge culture in an aerated rotating biodisc contactor DCN CWT00455	"Synthetic wastewater containing 0–10% salt (NaCl) was treated in a rotating biodisc unit operating in continuous mode. Salt tolerant, Halobacter halobium-supplemented activated sludge culture was used in order to alleviate salt inactivation effects. Effe	Publication; Copyrighted Material	Kargi, F. and A.R. Dincer	09/23/1997	1998. Saline wastewater treatment halophile-supple activated sludge culture aerated rotating biodisc contactor Enzyme and Microbial Tech 22:427–433.	Centralized Waste Treaters	7	No	Yes	CWT00455

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5.0	EPA-HQ-OW-2015-0665-0913	Increased salinization of fresh water in the northeastern United States DCN CWT00456	"We observed chloride concentrations of up to 25% of the concentration of seawater in streams of Maryland, New York, and New Hampshire during winters, and chloride concentrations remaining up to 100 times greater than unimpacted forest streams during summ	Publication; Copyrighted Material	Kaushal, S.S., P.M. Groffman, G.E. Likens,	09/20/2005	2005. Increased salinization of fresh water in the northeastern US Proc. Natl. Acad. Sci. U.S.A. 102(38):13517–13520.	Centralized Waste Treaters	4	No	Yes	CWT00456
5.0	EPA-HQ-OW-2015-0665-0914	High calcium concentration in water increases mortality of salmon and trout eggs DCN CWT00457	"Several experiments were conducted to investigate the effect of water chemistry during water hardening on survival of eggs of Atlantic salmon (Salmo salar), rainbow trout (Salmo gairdneri), and. brook trout (Salvelinus fontinalis). Results of these exper	Publication; Copyrighted Material	Ketola, H.G., D. Longacre, A. Greulich, L.	01/01/1988	1988. High calcium concentration in water increases mortality of salmon and trout eggs. Progressive Fish-Culturist 50(3):129–135.	Centralized Waste Treaters	7	No	Yes	CWT00457
5.0	EPA-HQ-OW-2015-0665-0915	Toxicity of metals to a tubifcid worm, Tubifex tubifex (Muller) DCN CWT00458	"Tubificid worms are useful indicators of varying degrees of aquatic pollution (Auston 1973). It is suggested that tubificid worms are an important element in the aquatic environment and therefore their use as a bioassay organism is logical one. The impor	Publication; Copyrighted Material	Khangarot, B.S	01/01/1991	1991 Journal of the Bulletin of Environmental Contamination and Toxicology 46:906–912.	Centralized Waste Treaters	7	No	Yes	CWT00458

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5.0	EPA-HQ-OW-2015-0665-0916	Stream fish community responses to a gradient of specific conductance DCN CWT00459	"We assessed the impacts of a specific conductance gradient attributable to treated coal-mining discharges on the fish communities of a southwestern Pennsylvania stream. Total dissolved solids concentrations were determined from specific conductance value	Publication; Copyrighted Material	Kimmel, W. and D. Argent	05/12/2009	Kimmel, W. and D. Argent. 2010. Stream fish community responses to a gradient of specific conductance. Water Air Soil Pollution 206:49.	Centralized Waste Treaters	8	No	Yes	CWT00459
5.0	EPA-HQ-OW-2015-0665-0917	Survival to hatching of fishes in sulfate-saline waters, Devils Lake, North Dakota DCN CWT00460	"Laboratory-based bioassays were conducted to determine concentrations of sodium-sulfate type salinities that limit the hatching success of several fish species. Survival to hatching (SH) was significantly lower ($P < 0.05$) in sodium-sulfate type waters fr	Publication; Copyrighted Material	Koel, T.M. and J.J. Peterka	01/01/1995	1995. Survival to hatching of fishes in sulfate-saline waters, Devils Lake, North Dakota. Canadian Journal Fisheries and Aquatic Sciences 52:464–469.	Centralized Waste Treaters	6	No	Yes	CWT00460
5.0	EPA-HQ-OW-2015-0665-0918	The impact of commercially treated oil and gas produced water discharges on bromide concentrations & modeled brominated trihalomethane disinfection byproducts at two downstream municipal drinking water plants in the upper Allegheny River, PA DCN CWT00461	"This study focused on quantifying the contribution of Br^- from a commercial wastewater treatment facility (CWTF) that solely treats wastes from oil and gas producers and discharges into the upper reaches of the Allegheny River, and impacts on two downstr	Publication; Copyrighted Material	Landis, M.S., A.S. Kamal, K.D. Kovalcik, C	11/03/2015	2016. Science of the Total Environment 542:505–520.	Centralized Waste Treaters	16	No	Yes	CWT00461

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5.0	EPA-HQ-OW-2015-0665-0919	Brine spills associated with unconventional oil development in North Dakota DCN CWT00462	"Here, we characterize the major and trace element chemistry and isotopic ratios (87Sr/86Sr, δ18O, δ2H) of surface waters (n = 29) in areas impacted by oil and gas wastewater spills in the Bakken region of North Dakota. We establish geochemical and isotop	Publication; Copyrighted Material	Lauer, N.E., J.S. Harkness, and A. Vengosh	04/27/2016	2016. Brine spills associated with unconventional oil development in North Dakota. Environ. Sci. Technol. 50(10):5389–439 7.	Centralized Waste Treaters	9	No	Yes	CWT00462
5.0	EPA-HQ-OW-2015-0665-0920	Treatment of organic pollution in industrial saline wastewater: A literature review DCN CWT00463	"Many industrial sectors are likely to generate highly saline wastewater: these include the agro-food, petroleum and leather industries. The discharge of such wastewater containing at the same time high salinity and high organic content without prior trea	Publication; Copyrighted Material	Lefebvre, O. and R. Moletta	01/01/2006	Lefebvre, O. and R. Moletta. 2006. Treatment of organic pollution in industrial saline wastewater: A literature review. Water Research 40(2):3671–3682 .	Centralized Waste Treaters	12	No	Yes	CWT00463
5.0	EPA-HQ-OW-2015-0665-0921	Shipping Radioactive Waste a Hot Issue in Drilling Sector DCN CWT00464	Document is a periodical article discussing the transportation of radioactive wastes resulting from drilling operations.	Publication; Copyrighted Material	Litvak, A	04/04/2016	Litvak, A. 2016. Shipping Radioactive Waste a Hot Issue in Drilling Sector. April 4. Pittsburgh Post-Gazette. Available: http://powersourc e.post-gazette.com/pow ersource/policy-powersource/201	Centralized Waste Treaters	6	No	Yes	CWT00464

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5.0	EPA-HQ-OW-2015-0665-0922	Unconventional oil and gas spills: Materials, volumes, and risks to surface waters in four states of the U.S. DCN CWT00465	"We analyzed spill data associated with unconventional wells from Colorado, New Mexico, North Dakota and Pennsylvania from 2005 to 2014, where we defined unconventional wells as horizontally drilled into an unconventional formation. We identified material	Publication; Copyrighted Material	Maloney, K.O., S. Baruch-Mordo, L.A. Patte	12/30/2016	2017. UOG spills: Materials, volumes, and risks to surface waters in four states of the U.S. Science of the Total Environment 581–582:369–377.	Centralized Waste Treaters	9	No	Yes	CWT00465
5.0	EPA-HQ-OW-2015-0665-1058	Occurrence and consequences of increased bromide in drinking water sources DCN CWT00466	"Elevated concentrations of brominated disinfection by-products (DBPs) have been reported recently by some drinking water utilities. Some of these occurrences have been correlated with upstream discharges of bromide-containing wastes from coal-fired power	Publication; Copyrighted Material	McTigue, N.E., D.A. Cornwell, K. Graf, and	11/01/2014	2014. Occurrence and consequences of increased bromide in drinking water sources. Journal American Water Works Association 106(11):E492–E508.	Centralized Waste Treaters	17	No	Yes	CWT00466
5.0	EPA-HQ-OW-2015-0665-0923	Salinity/toxicity relationship to predict the acute toxicity of produced waters to freshwater organisms DCN CWT00467	"As part of previous research, the Gas Research Institute, ENSR, and the University of Wyoming developed a series of multivariate logistic regression equations (called Salinity/Toxicity Relationships or STRS) that predict acute toxicity to three freshwate	Publication; Copyrighted Material	Mount, D.R., D.D. Gulley, and J.M. Evans	01/01/1993	1993. Salinity/toxicity relationship predict acute toxicity Proceedings, 1st Society of Petro Eng/USEPA Env Conf, San Antonio, TX. pp. 605–614.	Centralized Waste Treaters	10	No	Yes	CWT00467

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5.0	EPA-HQ-OW-2015-0665-0924	Statistical models to predict the toxicity of major ions to Ceriodaphnia dubia, Daphnia magna and Pimephales promelas (fathead minnows) DCN CWT00468	"To provide a predictive tool to assess toxicity attributable to major ions, we tested the toxicity of over 2,900 ion solutions using the daphnids, Ceriodaphnia dubia and Daphnia magna, and fathead minnows (Pimephales promelas). Multiple logistic regressi	Publication; Copyrighted Material	Mount, D.R., D.D. Gulley, J.R. Hockett, T.	02/20/1997	1997 Stat models predict toxicity major ions Ceriodaphnia dubia Daphnia magna - Env Toxicology and Chemistry 16(10):2009–2019.	Centralized Waste Treaters	11	No	Yes	CWT00468
10.31	EPA-HQ-OW-2015-0665-0752	CBI_Final Site Visit Report for Carlisle Interconnect Technologies - DCN MF00111CBI	CBI_Final Site visit report prepared by ERG from the site visit at Carlisle Interconnect Technologies on May 16, 2016. Draft Incorporates facility and EPA comments.	Report	U.S. EPA	06/05/2017	U.S. EPA. 2017. CBI Final Site Visit Report for Carlisle Interconnect Technologies.	Metal Finishing, Part 433	17	Yes	No	MF00111
10.31	EPA-HQ-OW-2015-0665-0753	CBI_Memorandum to Ahmar Siddiqui, EPA; Subject: Notes from the Meeting with SRG Global Inc. on June 15, 2016 - DCN MF00112CBI	CBI_Final Notes for Meeting with SRG Global Inc. on June 15, 2016.	Memorandum	U.S. EPA	10/06/2016	ERG, 2016. CBI Memorandum to Ahmar Siddiqui, EPA. Subject: Notes from the Meeting with SRG Global Inc. on June 15, 2016.	Metal Finishing, Part 433	6	Yes	No	MF00112

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10.31	EPA-HQ-OW-2015-0665-0754	CBI_Final Metal Finishing Site Visit Report for PB Fasteners - DCN MF00113CBI	CBI_Final Site visit report prepared by ERG from the site visit at PB Fasteners on May 17, 2016. Draft incorporates facility and EPA comments.	Report	U.S. EPA	03/07/2017	U.S. EPA. 2017. CBI Final Metal Finishing Site Visit Report for PB Fasteners.	Metal Finishing, Part 433	9	Yes	No	MF00113
10.31	EPA-HQ-OW-2015-0665-0755	Final Metal Finishing Site Visit Report for Northrop Grumman - DCN MF00114	Final Site Visit Report prepared by ERG from the site visit at Northrop Grumman on May 19, 2016.	Report	U.S. EPA	06/05/2017	U.S. EPA. 2017. Final Metal Finishing Site Visit Report for Northrop Grumman.	Metal Finishing, Part 433	6	No	No	MF00114
10.31	EPA-HQ-OW-2015-0665-0756	Quality Assurance Activities for the Collection of Existing Data to Support the Metal Finishing Preliminary Study - Revision 1 - DCN MF00115	Memorandum describes quality assurance procedures ERG will use for the selection of metal finishing sites and existing data collection during site visits under the Metal Finishing Preliminary Study.	Memorandum	Dan-Tam Nguyen, ERG	01/19/2016	ERG. 2016. Memorandum to U.S. EPA from ERG. Re: QA Activities for the Collection of Existing Data to Support the Metal Finishing Preliminary Study	Metal Finishing, Part 433	10	No	No	MF00115

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10.31	EPA-HQ-OW-2015-0665-0757	Approach for the Review of the Metal Products and Machinery (MP&M) Rulemaking Documentation - DCN MF00116	Memorandum summarizing EPA's objectives, data sources, documentation, and QA/QC steps for review of the Metal Products and Machinery (MP&M) Rulemaking.	Memorandum	Ryan Novak, ERG	02/22/2016	ERG. 2016. Memorandum to U.S. EPA, from ERG. Re: Approach for the Review of MP&M Rulemaking Documentation	Metal Finishing, Part 433	9	No	No	MF00116
10.31	EPA-HQ-OW-2015-0665-0844	Metal Products and Machinery (MP&M) Rulemaking Documentation: Screening Review Results and Proposed Approach for Detailed Review - DCN MF00117	Memorandum describing the objectives, methodology, results, and potential next steps for the screening review of Metal Products and Machinery (MP&M) Rulemaking Documentation.	Memorandum	Ryan Novak, ERG	09/19/2016	ERG. 2016. Memorandum to U.S. EPA from ERG. Re: MP&M Rulemaking Documentation: Screening Review Results and Proposed Approach for Detailed Review.	Metal Finishing, Part 433	19	No	No	MF00117
10.31	EPA-HQ-OW-2015-0665-0844.1	MP&M Rulemaking Initial Screening Tracking Sheet - DCN MF00117A1	Memorandum attachment (spreadsheet) with brief descriptions, data sources, and ERG recommendations for data sources analyzed during the screening review.	Data	Ryan Novak, ERG	09/19/2016	ERG. 2016. Memorandum to U.S. EPA from ERG. Re: MP&M Documentation: Screening Review Results and Proposed Approach for Detailed Review - Att.	Metal Finishing, Part 433	0	No	No	MF00117A1

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10.31	EPA-HQ-OW-2015-0665-0758	Metal Finishing Study: Plan for Identifying Pollution Prevention Practices in the Metal Finishing Industry - DCN MF00118	The memorandum presents ERG's plan for the P2 review including the data sources, objectives, review plan, and QA/QC steps	Memorandum	Anna Dimling, ERG	03/10/2017	ERG. 2017. Plan for Identifying Pollution Prevention Practices in the Metal Finishing Industry.	Metal Finishing, Part 433	9	No	No	MF00118
10.31	EPA-HQ-OW-2015-0665-1062	CBI_Final Metal Finishing Site Visit Report for Hill Air Force Base - DCN MF00119CBI	CBI_Final site visit report prepared by ERG from the site visit at Hill Air Force Base on July 11, 2016.	Report	U.S. EPA	08/24/2017	U.S. EPA. 2017. CBI Final Metal Finishing Site Visit Report for Hill Air Force Base.	Metal Finishing, Part 433	29	Yes	No	MF00119
10.31	EPA-HQ-OW-2015-0665-1062.1	CBI_IWCS Report for Building 505 - DCN MF00119.A1CBI	CBI_IWCS Report for Hill Air Force Base Building 505. Attachment to the Final Site Visit Report for the site visit at Hill Air Force Base.	Report	Hill Air Force Base	08/29/2016	HAFB. 2016. CBI IWCS Report for Building 505.	Metal Finishing, Part 433	49	Yes	No	MF00119A1

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10.31	EPA-HQ-OW-2015-0665-1062.2	CBI_IWCS Report for Building 507 - DCN MF00119.A2CBI	CBI_IWCS Report for Hill Air Force Base Building 507. Attachment to the Final Site Visit Report for the site visit at Hill Air Force Base.	Report	Hill Air Force Base	08/29/2016	HAFB. 2016. CBI IWCS Report for Building 507.	Metal Finishing, Part 433	40	Yes	No	MF00119A2
10.31	EPA-HQ-OW-2015-0665-1062.3	CBI_Historical Monitoring Data - DCN MF00119.A3CBI	CBI_Historical Monitoring Data for Hill Air Force Base Industrial Waste Treatment Plant. Attachment to the Final Site Visit Report for the site visit at Hill Air Force Base.	Report	Hill Air Force Base	09/01/2016	HAFB. 2016. CBI Historical Monitoring Data.	Metal Finishing, Part 433	0	Yes	No	MF00119A3
10.31	EPA-HQ-OW-2015-0665-1062.4	CBI_Quanity and Quality of Industrial Waste Collection System Discharges for Hill Air Force Base - DCN MF00119.A4CBI	CBI_Report from a study to quantify industrial waste discharges to the Hill Air Force Base IWCS from select buildings on base. Report also presents water quality data. Attachment to the Final Site Visit Report for the site visit at Hill Air Force Base.	Report	Stantec	03/01/2017	Stantec. 2017. CBI IWCS Discharge Report.	Metal Finishing, Part 433	726	Yes	No	MF00119A4

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10.31	EPA-HQ-OW-2015-0665-0759	CBI_Final Metal Finishing Site Visit Report for Williams International - DCN MF00120CBI	CBI_Final Site visit report prepared by ERG from the site visit at Williams International on July 12, 2016. Draft incorporates facility and EPA comments.	Report	U.S. EPA	07/31/2017	U.S. EPA. 2017. CBI Final Metal Finishing Site Visit Report for Williams International.	Metal Finishing, Part 433	8	Yes	No	MF00120
10.31	EPA-HQ-OW-2015-0665-0760	CBI_Final Metal Finishing Site Visit Report for Blanchard Metal Processing - DCN MF00121CBI	CBI_Final Site visit report prepared by ERG from the site visit at Blanchard Metal Processing on July 13, 2016. Draft incorporates facility and EPA comments.	Report	U.S. EPA	01/12/2017	U.S. EPA. 2017. CBI Final Metal Finishing Site Visit Report for Blanchard Metal Processing.	Metal Finishing, Part 433	12	Yes	No	MF00121
10.31	EPA-HQ-OW-2015-0665-0761	CBI_Final Metal Finishing Site Visit Report for Pilkington Metal Finishing LLC - DCN MF00122CBI	CBI_Final Site visit report prepared by ERG from the site visit at Pilkington Metal Finishing LLC on July 13, 2016. Draft incorporates facility and EPA comments.	Report	U.S. EPA	06/21/2017	U.S. EPA. 2017. CBI Final Metal Finishing Site Visit Report for Pilkington Metal Finishing LLC.	Metal Finishing, Part 433	28	Yes	No	MF00122

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10.31	EPA-HQ-OW-2015-0665-0762	CBI_Final Metal Finishing Site Visit Report for O.C. Tanner Manufacturing Company - DCN MF00123CBI	CBI_Final Site visit report prepared by ERG from the site visit at O.C. Tanner Manufacturing Company on July 14, 2016. Draft incorporates facility and EPA comments.	Report	U.S. EPA	06/21/2017	U.S. EPA. 2017. CBI Final Metal Finishing Site Visit Report for O.C. Tanner Manufacturing Company.	Metal Finishing, Part 433	24	Yes	No	MF00123
10.31	EPA-HQ-OW-2015-0665-0763	Final Metal Finishing Site Visit Report for Varian Metal System X-Ray Products - DCN MF00124	Final Site visit report prepared by ERG from the site visit at Varian Metal System X-Ray Products on July 14, 2016. Draft incorporates facility and EPA comments.	Report	U.S. EPA	08/23/2017	U.S. EPA. 2017. Final Metal Finishing Site Visit Report for Varian Metal System X-Ray Products.	Metal Finishing, Part 433	13	No	No	MF00124
10.31	EPA-HQ-OW-2015-0665-0764	Toxic Release Inventory (TRI) Pollution Prevention (P2) Data Summary - DCN MF00125	The memorandum summarizes pollution prevention (P2) practices in 2011 through 2015 Toxic Release Inventory (TRI) P2 data.	Memorandum	Anna Dimling, ERG	03/29/2017	ERG. 2017. Memorandum to U.S. EPA from ERG. Re: TRI P2 Data Summary. (March 29).	Metal Finishing, Part 433	21	No	No	MF00125

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10.31	EPA-HQ-OW-2015-0665-0765	Final Metal Finishing Site Visit Report for Plymouth Plating Works - DCN MF00126	Final Site visit report prepared by ERG from the site visit at Plymouth Plating Works on August 15, 2016.	Report	U.S. EPA	07/14/2017	U.S. EPA. 2017. Final Metal Finishing Site Visit Report for Plymouth Plating Works.	Metal Finishing, Part 433	27	No	No	MF00126
10.31	EPA-HQ-OW-2015-0665-0766	CBI_Final Metal Finishing Site Visit Report for KC Jones Plating Company - DCN MF00127CBI	CBI_Final Site visit report prepared by ERG from the site visit at KC Jones Plating Company on August 15, 2016.	Report	U.S. EPA	07/14/2017	U.S. EPA. 2017. CBI Final Metal Finishing Site Visit Report for KC Jones Plating Company.	Metal Finishing, Part 433	23	Yes	No	MF00127
10.31	EPA-HQ-OW-2015-0665-0767	CBI_Final Metal Finishing Site Visit Report for AJAX Metal Processing - DCN MF00128CBI	CBI_Final Site visit report prepared by ERG from the site visit at AJAX Metal Processing on August 16, 2016.	Report	U.S. EPA	07/14/2017	U.S. EPA. 2017. CBI Final Metal Finishing Site Visit Report for AJAX Metal Processing.	Metal Finishing, Part 433	15	Yes	No	MF00128

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10.31	EPA-HQ-OW-2015-0665-0768	CBI_Final Metal Finishing Site Visit Report for Ford Flat Rock - DCN MF00129CBI	CBI_Final Site visit report prepared by ERG from the site visit at Ford Flat Rock on August 16, 2016.	Report	U.S. EPA	07/14/2017	U.S. EPA. 2017. CBI Final Metal Finishing Site Visit Report for Ford Flat Rock.	Metal Finishing, Part 433	12	Yes	No	MF00129
10.31	EPA-HQ-OW-2015-0665-0769	Final Metal Finishing Site Visit Report for Elm Plating - DCN MF00130	Final Site visit report prepared by ERG from the site visit at Elm Plating Company on August 17, 2016. Draft incorporates facility and EPA comments.	Report	U.S. EPA	07/14/2017	U.S. EPA. 2017. Final Metal Finishing Site Visit Report for Elm Plating.	Metal Finishing, Part 433	24	No	No	MF00130
10.31	EPA-HQ-OW-2015-0665-0770	Final Metal Finishing Site Visit Report for Trion Coatings - DCN MF00131	Final Site visit report prepared by ERG from the site visit at Trion Coatings on August 17, 2016. Draft incorporates facility and EPA comments.	Report	U.S. EPA	07/14/2017	U.S. EPA. 2017. Final Metal Finishing Site Visit Report for Trion Coatings.	Metal Finishing, Part 433	5	No	No	MF00131

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10.31	EPA-HQ-OW-2015-0665-0771	Final Metal Finishing Site Visit Report for Methode Electronics, Inc. - DCN MF00132	CBI_Final Site visit report prepared by ERG from the site visit at Methode Electronics, Inc. on August 18, 2016. Draft incorporates facility and EPA comments.	Report	U.S. EPA	07/14/2017	U.S. EPA. 2017. Final Metal Finishing Site Visit Report for Methode Electronics, Inc.	Metal Finishing, Part 433	9	No	No	MF00132
10.31	EPA-HQ-OW-2015-0665-0772	Final Metal Finishing Site Visit Report for Eagle Electronics - DCN MF00133	Final Site visit report prepared by ERG from the site visit at Eagle Electronics on August 18, 2016. Draft incorporates facility and EPA comments.	Report	U.S. EPA	07/14/2017	U.S. EPA. 2017. Final Metal Finishing Site Visit Report for Eagle Electronics.	Metal Finishing, Part 433	17	No	No	MF00133
10.31	EPA-HQ-OW-2015-0665-0773	CBI_Final Metal Finishing Site Visit Report for Metal Impact LLC - DCN MF00134CBI	CBI_Final Site visit report prepared by ERG from the site visit at Metal Impact LLC on August 19, 2016. Draft incorporates facility and EPA comments.	Report	U.S. EPA	07/10/2017	U.S. EPA. 2017. CBI Final Metal Finishing Site Visit Report for Metal Impact LLC.	Metal Finishing, Part 433	16	Yes	No	MF00134

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10.31	EPA-HQ-OW-2015-0665-0774	CBI_Final Metal Finishing Site Visit Report for Magnetic Inspection Laboratory Inc. - DCN MF00135CBI	CBI_Final Site Visit report prepared by ERG from the site visit at Magnetic Inspection Laboratory Inc. on August 19, 2016. Draft incorporates facility and EPA comments.	Report	U.S. EPA	07/10/2017	U.S. EPA. 2017. CBI Final Metal Finishing Site Visit Report for Magnetic Inspection Laboratory Inc.	Metal Finishing, Part 433	17	Yes	No	MF00135
10.31	EPA-HQ-OW-2015-0665-0775	Metal Finishing Preliminary Study: Proposed Approach for Phase I Review of DMR and TRI Data - DCN MF00136	Memorandum describing the approach for the Phase I DMR and TRI data review.	Memorandum	Anna Dimling, ERG	11/06/2015	ERG. 2015. Memorandum to U.S. EPA from ERG. Re: Metal Finishing Preliminary Study: Proposed Approach for Phase I Review of DMR and TRI Data.	Metal Finishing, Part 433	11	No	No	MF00136
10.31	EPA-HQ-OW-2015-0665-0845	Metal Finishing Preliminary Study: Phase I Results and Proposed Approach for Phase II Review of DMR and TRI Data - DCN MF00137	Memorandum describing the approach for the Phase II DMR and TRI data review and presenting the results from Phase I review.	Memorandum	Anna Dimling, ERG	01/15/2016	ERG. 2016. Metal Finishing Preliminary Study: Phase I Results and Proposed Approach for Phase II Review of DMR and TRI Data.	Metal Finishing, Part 433	13	No	No	MF00137

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10.31	EPA-HQ-OW-2015-0665-0845.1	DMR and TRI Phase I Review Results Memo Attachment - DCN MF00137A1	Attachment to the Phase II Memo providing the results from the Phase I Review of the DMR and TRI data.	Memorandum	Anna Dimling, ERG	03/15/2016	ERG. 2016. Attachment to MF Preliminary Study: Phase I Results and Proposed Approach for Phase II Review of DMR and TRI Data.	Metal Finishing, Part 433	0	No	No	MF00137A1
10.31	EPA-HQ-OW-2015-0665-0846	Metal Finishing Preliminary Study: Summary of Phase I and Phase II Review of DMR and TRI Data - DCN MF00138	Memorandum summarizing the Phase I and Phase II Review of the DMR and TRI Data and presenting the results of the Phase II Review.	Memorandum	Anna Dimling, ERG	04/07/2017	ERG. 2017. Memorandum to U.S. EPA from Anna Dimling, ERG. Re: MF Preliminary Study: Summary of Phase I and Phase II Review of DMR and TRI Data.	Metal Finishing, Part 433	24	No	No	MF00138
10.31	EPA-HQ-OW-2015-0665-0846.1	DMR and TRI Phase II Review Results Memo Attachment - DCN MF00138A1	Attachment to DMR/TRI Summary Memo that provides the results from the Phase II Review of the DMR and TRI Data	Memorandum	Anna Dimling, ERG	04/07/2017	ERG. 2017. Attachment to MF Preliminary Study: Summary of Phase I and Phase II Review of DMR and TRI Data.	Metal Finishing, Part 433	0	No	No	MF00138A1

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10.31	EPA-HQ-OW-2015-0665-0847	Federal-Mogul Corporation NPDES Permit - DCN MF00139	Wastewater discharge permit application for Federal-Mogul Corporation in Greenville, Michigan.	Permit, Registration	MI DEQ	12/31/2013	MI DEQ. 2013. Federal-Mogul Corporation NPDES Permit.	Metal Finishing, Part 433	7	No	No	MF00139
10.31	EPA-HQ-OW-2015-0665-0847.1	Federal-Mogul Corporation NPDES Permit Flow Confirmation - DCN MF00139A1	Email documentation for NPDES permit application for Federal-Mogul Corporation	Permit, Registration	MI DEQ	08/05/2015	MI DEQ. 2015. Federal-Mogul Corporation NPDES Permit Flow Confirmation.	Metal Finishing, Part 433	3	No	No	MF00139A1
10.31	EPA-HQ-OW-2015-0665-0847.2	Federal-Mogul Corporation NPDES Permit Process Flow Diagram - DCN MF00139A2	Attachment to wastewater treatment permit for Federal-Mogul Corporation with wastewater flow diagram.	Permit, Registration	Federal-Mogul	12/31/2013	MI DEQ. 2013. Federal-Mogul Corporation NPDES Permit Process Flow Diagram.	Metal Finishing, Part 433	3	No	No	MF00139A2

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10.31	EPA-HQ-OW-2015-0665-0776	Facility Contact Telecon: Double Eagle Steel Coating Co. - DCN MF00140	Summary of telephone conversation with Steve Ford about Double Eagle Steel Coating Co. in Dearborn, MI.	Report	Anna Dimling, ERG	03/23/2016	ERG. 2016. Facility Contact Telecon: Double Eagle Steel Coating Co.	Metal Finishing, Part 433	2	No	No	MF00140
10.31	EPA-HQ-OW-2015-0665-0777	Facility Contact Telecon: Global Foundries East Fishkill Facility - DCN MF00141	Summary of telephone conversation with Gary Marone about East Fishkill Facility in Hopewell Junction, NY.	Report	Anna Dimling, ERG	03/24/2016	ERG. 2016. Facility Contact Telecon: Global Foundries East Fishkill Facility.	Metal Finishing, Part 433	3	No	No	MF00141
10.31	EPA-HQ-OW-2015-0665-0778	Facility Contact Telecon: Electro-Spec Inc. - DCN MF00142	Summary of telephone conversation with Ben McKnight about Electro-Spec Inc. facility in Franklin, IN.	Report	Anna Dimling, ERG	03/22/2016	ERG. 2016. Facility Contact Telecon: Electro-Spec Inc.	Metal Finishing, Part 433	1	No	No	MF00142

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10.31	EPA-HQ-OW-2015-0665-0779	Facility Contact Telecon: George Industries - DCN MF00143	Summary of telephone conversation with Eric Herrera about George Industries in Los Angeles, CA.	Report	Anna Dimling, ERG	04/13/2016	ERG. 2016. Facility Contact Telecon: George Industries.	Metal Finishing, Part 433	2	No	No	MF00143
10.31	EPA-HQ-OW-2015-0665-0780	Facility Contact Telecon: General Motors LLC Toledo - DCN MF00144	Summary of telephone conversation with Joyce Arakelian about General Motors LLC in Toledo, OH.	Report	Anna Dimling, ERG	03/22/2016	ERG. 2016. Facility Contact Telecon: General Motors LLC Toledo.	Metal Finishing, Part 433	1	No	No	MF00144
10.31	EPA-HQ-OW-2015-0665-0781	Facility Contact Telecon: Graftech International Holdings, Inc. - DCN MF00145	Summary of telephone conversation with Juanita Bursley about GrafTech International Holdings Inc. in Parma, OH.	Report	Anna Dimling, ERG	03/23/2016	ERG. 2016. Facility Contact Telecon: Graftech International Holdings, Inc.	Metal Finishing, Part 433	2	No	No	MF00145

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10.31	EPA-HQ-OW-2015-0665-0782	Facility Contact Telecon: Huntington Ingalls, Inc. - DCN MF00146	Summary of telephone conversation with Steve Brinkman about Huntington Ingalls, Inc. in Newport News, VA.	Report	Anna Dimling, ERG	04/20/2016	ERG. 2016. Facility Contact Telecon: Huntington Ingalls, Inc.	Metal Finishing, Part 433	3	No	No	MF00146
10.31	EPA-HQ-OW-2015-0665-0783	Facility Contact Telecon: Kokomo Transmission Plant - DCN MF00147	Summary of telephone conversation with Al Johnston about FCA US Kokomo Transmission Plant in Kokomo, IN.	Report	Anna Dimling, ERG	03/24/2016	ERG. 2016. Facility Contact Telecon: Kokomo Transmission Plant.	Metal Finishing, Part 433	6	No	No	MF00147
10.31	EPA-HQ-OW-2015-0665-0784	Facility Contact Telecon: Korns Galvanizing Co Inc. - DCN MF00148	Summary of telephone conversation with Barry Heider about Korns Galvanizing Co. Inc. in Johnstown, PA.	Report	Anna Dimling, ERG	03/23/2016	ERG. 2016. Facility Contact Telecon: Korns Galvanizing Co Inc.	Metal Finishing, Part 433	1	No	No	MF00148

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10.31	EPA-HQ-OW-2015-0665-0785	Facility Contact Telecon: Marisco, LTD - DCN MF00149	Summary of telephone conversation with Steve Hinton about Marisco, LTD. in Kapolei, HI.	Report	Anna Dimling, ERG	03/18/2016	ERG. 2016. Facility Contact Telecon: Marisco, LTD.	Metal Finishing, Part 433	1	No	No	MF00149
10.31	EPA-HQ-OW-2015-0665-0786	Facility Contact Telecon: SGL Carbon Group - DCN MF00150	Summary of telephone conversation with Lee Gjetley about SGL Carbon Group (Great Lakes Carbon Corp.) in Morgantown, NC.	Report	Anna Dimling, ERG	03/22/2016	ERG. 2016. Facility Contact Telecon: SGL Carbon Group.	Metal Finishing, Part 433	1	No	No	MF00150
10.31	EPA-HQ-OW-2015-0665-0787	Facility Contact Telecon: Toray Carbon Fibers America Inc. - DCN MF00151	Summary of telephone conversation with Mike Conlon about Toray Carbon Fibers America Inc. in Decatur, AL.	Report	Anna Dimling, ERG	03/22/2016	ERG. 2016. Facility Contact Telecon: Toray Carbon Fibers America Inc.	Metal Finishing, Part 433	1	No	No	MF00151

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10.31	EPA-HQ-OW-2015-0665-0788	Facility Contact Telecon: SRG Global Portageville facility - DCN MF00152	Summary of telephone conversation with Steve Sherriff about SRG Global in Portageville, MO.	Report	Anna Dimling, ERG	03/23/2016	ERG. 2016. Facility Contact Telecon: SRG Global Portageville facility.	Metal Finishing, Part 433	1	No	No	MF00152
10.31	EPA-HQ-OW-2015-0665-0789	Memorandum to Ahmar Siddiqui, EPA; Subject: Notes from the Meeting with SRG Global Inc. on June 15, 2016 - DCN MF00153	Final sanitized notes for Meeting with SRG Global Inc. on June 15, 2016.	Memorandum	Anna Dimling, ERG	10/06/2016	ERG. 2016. Memorandum to Ahmar Siddiqui, EPA; Subject: Notes from the Meeting with SRG Global Inc. on June 15, 2016.	Metal Finishing, Part 433	6	No	No	MF00153
10.31	EPA-HQ-OW-2015-0665-1097	DMR Data Analysis Database - DCN MF00154	Collected discharge monitoring report (DMR) data for 2010 through 2014 to perform various queries for DMR/TRI Phase I and Phase II Review.	Data	ERG	05/26/2017	ERG. 2017. DMR Data Analysis Database.	Metal Finishing, Part 433	0	No	No	MF00154

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10.31	EPA-HQ-OW-2015-0665-1098	TRI Data Analysis Database - DCN MF00155	Collected toxics release inventory (TRI) data for 2010 through 2014 to perform various queries for DMR/TRI Phase I and Phase II Review.	Data	ERG	05/26/2017	ERG. 2017. TRI Data Analysis Database.	Metal Finishing, Part 433	0	No	No	MF00155
10.31	EPA-HQ-OW-2015-0665-1099	TRI Data Request Analyses Database - DCN MF00156	Underlying concentration data received from facilities supporting releases reported to TRI.	Data	ERG	05/26/2017	ERG. 2017. TRI Data Request Analyses Database.	Metal Finishing, Part 433	0	No	No	MF00156
10.31	EPA-HQ-OW-2015-0665-0790	Summary of Discussions with Local POTW Pretreatment Coordinators - DCN MF00157	Memorandum describing the discussion with Local POTW Pretreatment Coordinators during Utah Metal Finishing Site Visits in July 2016.	Report	Dan-Tam Nguyen, ERG	03/07/2017	ERG. 2017. Memorandum to U.S. EPA from ERG. Re: Summary of Discussions with Local POTW Pretreatment Coordinators.	Metal Finishing, Part 433	3	No	No	MF00157

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10.31	EPA-HQ-OW-2015-0665-0972	Sanitized_Final Metal Finishing Site Visit Report for PB Fasteners - DCN MF00158	Final sanitized site visit report prepared by ERG from the site visit at PB Fasteners on May 17, 2016.	Report	U.S. EPA	03/07/2017	U.S. EPA. 2017. Sanitized Final Metal Finishing Site Visit Report for PB Fasteners.	Metal Finishing, Part 433	4	No	No	MF00158
10.31	EPA-HQ-OW-2015-0665-0988	Facility Comments on Draft Metal Finishing Site Visit Report from Northrop Grumman - DCN MF00159	Contains facility comments on draft report for site visit to Northrop Grunman	Report	Northrop Grunman	10/26/2016	Northrop Grunman. 2016. Facility Comments on Draft Metal Finishing Site Visit Report from Northrop Grumman.	Metal Finishing, Part 433	13	No	No	MF00159
10.31	EPA-HQ-OW-2015-0665-0971	CBI_Facility Comments on Draft Metal Finishing Site Visit Report from Carlisle Interconnect Technologies - DCN MF00160CBI	CBI_Contains facility comments on draft report for site visit to Carlisle Interconnect Technologies	Report	Carlisle	08/23/2016	Carlisle. 2016. Facility Comments on Draft Metal Finishing Site Visit Report from Carlisle Interconnect Technologies.	Metal Finishing, Part 433	18	Yes	No	MF00160

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10.31	EPA-HQ-OW-2015-0665-0971.1	CBI_Carlisle Interconnect Technologies Cover Letter for Comments on Site Visit Report - DCN MF00160A1CBI	CBI_Contains notes on Carlisle's comments on the draft site visit report.	Report	Carlisle	08/23/2016	Carlisle. 2016. Carlisle Interconnect Technologies Cover Letter for Comments on Site Visit Report.	Metal Finishing, Part 433	1	Yes	No	MF00160A1
10.31	EPA-HQ-OW-2015-0665-0971.2	CBI_Sanitation Districts of Los Angeles County Industrial Wastewater Discharge Permit Data Sheet - DCN MF00160A2CBI	CBI_NPDES Permit data sheet for Carlisle Interconnect Technologies; approved April 3, 2013.	Permit, Registration	LA Sanitation Districts	04/02/2013	LA Sanitation Districts. 2013. Sanitation Districts of Los Angeles County Industrial Wastewater Discharge Permit Data Sheet.	Metal Finishing, Part 433	9	Yes	No	MF00160A2
10.31	EPA-HQ-OW-2015-0665-0971.3	CBI_Safety Data Sheets for Chemicals used at Carlisle Interconnect Technologies - DCN MF00160A3CBI	CBI_PDF containing 11 SDSs for Carlisle Interconnect Technologies	Report	Carlisle	08/23/2016	Carlisle. 2016. Safety Data Sheets for Chemicals used at Carlisle Interconnect Technologies.	Metal Finishing, Part 433	67	Yes	No	MF00160A3

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10.31	EPA-HQ-OW-2015-0665-0989	Sanitized_Final Metal Finishing Site Visit Report for Carlisle Interconnect Technologies - DCN MF00161	Final Sanitized Site Visit Report prepared by ERG for site visit at Carlisle Interconnect Technologies on May 16, 2016.	Report	U.S. EPA	06/05/2017	U.S. EPA. 2017. Sanitized Final Site Visit Report for Carlisle Interconnect Technologies.	Metal Finishing, Part 433	11	No	No	MF00161
10.31	EPA-HQ-OW-2015-0665-0791	Metal Products and Machinery (MP&M) Rulemaking Preamble: Summary of Industry Comments and EPA Decisions Related to the Metal Finishing Category - DCN MF00162	Summary of the MP&M Rulemaking Preamble, specifically items relevant to metal finishing and electroplating industries.	Memorandum	Molly McEvoy, ERG	03/20/3017	ERG. 2017. Memorandum to U.S. EPA from ERG. Re: MP&M Rulemaking Preamble: Summary of Industry Comments and EPA Decisions Related to the MF Category	Metal Finishing, Part 433	10	No	No	MF00162
10.31	EPA-HQ-OW-2015-0665-0792	Metal Products and Machinery (MP&M) Rulemaking TDD: Review and Comparison of Wastewater Technologies, Pollutants of Concern, and Pollution Prevention Practice (P2) Considered in the MP&M and Metal Finishing Rulemakings - DCN MF00163	Summary of the MP&M Rulemaking technical development document; specifically, identifying changes in the state of the metal finishing industry, wastewater technologies, etc., between the Metal Finishing rulemaking and the of the MP&M rulemaking.	Memorandum	Molly McEvoy, ERG	03/10/3017	ERG. 2017. Memorandum to U.S. EPA from ERG. Re: MP&M TDD: Review and Comparison of Wastewater Technologies, POC, and P2 Practices Considered.	Metal Finishing, Part 433	17	No	No	MF00163

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10.31	EPA-HQ-OW-2015-0665-0793	Results of the Targeted Review of the MP&M Comment Response Document: Pollution Prevention and Wastewater Treatment Practices - DCN MF00164	Results of the targeted review of MP&M CRD. CRD was searched for the keyword "pollution prevention" and comments relevant to the metal finishing and electroplating industries are summarized.	Memorandum	Molly McEvoy, ERG	03/21/2017	ERG. 2017. Memorandum to U.S. EPA from ERG. Re: Results of the Targeted Review of the MP&M CRD: P2 and Wastewater Treatment Practices.	Metal Finishing, Part 433	3	No	No	MF00164
10.31	EPA-HQ-OW-2015-0665-0794	Results of the Pollution Prevention Targeted Literature Review for the Metal Finishing Industry - DCN MF00165	Memorandum summarizing a targeted literature search for pollution prevention (P2) practices used in the metal finishing industry.	Memorandum	Adam OrnDorff, ERG	03/22/2017	ERG. 2017. Memorandum to U.S. EPA, from ERG. Re: Results of the Pollution Prevention Targeted Literature Review for the MF Industry.	Metal Finishing, Part 433	6	No	No	MF00165
10.31	EPA-HQ-OW-2015-0665-0795	Results of the Pollution Prevention Data Collection using E3 Sources and Regional Contacts in the Metal Finishing Industry - DCN MF00166	Memorandum summarizing results from reviewing E3 and regional contact information concerning metal finishing P2 practices.	Memorandum	Anna Dimling, ERG	04/21/2017	ERG. 2017. Memorandum to U.S. EPA from ERG. Re: Results of the P2 Data Collection using E3 Sources and Regional Contacts in the MF Industry.	Metal Finishing, Part 433	12	No	No	MF00166

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10.31	EPA-HQ-OW-2015-0665-0796	2012 NAICS to SIC Crosswalk - DCN MF00167	NAICS to SIC Crosswalk	Data	NAICS	01/01/2012	NAICS. 2012. 2012 NAICS to SIC Crosswalk.	Metal Finishing, Part 433	63	No	No	MF00167
10.31	EPA-HQ-OW-2015-0665-1069	CBI_General Comments on Draft Metal Finishing Site Visit Report for Hill Air Force Base - DCN MF00168CBI	CBI_Contains general facility comments on draft report for site visit to Hill Air Force Base	Memorandum	Hill Air Force Base	04/27/2017	HAFB. 2017. CBI_General Comments on Draft Metal Finishing Site Visit Report for Hill Air Force Base.	Metal Finishing, Part 433	2	Yes	No	MF00168
10.31	EPA-HQ-OW-2015-0665-1069.1	CBI_Facility Comments on Draft Metal Finishing Site Visit Report for Hill Air Force Base from Richard Whalen and Mark Ross - DCN MF00168A1CBI	CBI_Contains facility comments on draft report for site visit to Hill Air Force Base from Richard Whalen and Mark Ross	Report	Hill Air Force Base	04/27/2017	HAFB. 2017. CBI_Facility Comments on Draft Metal Finishing Site Visit Report for Hill Air Force Base from Richard Whalen and Mark Ross.	Metal Finishing, Part 433	17	Yes	No	MF00168A1

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10.31	EPA-HQ-OW-2015-0665-1069.2	CBI_Facility Comments on Draft Metal Finishing Site Visit Report for Hill Air Force Base from Caroline LeClair and Barbara Hall - DCN MF00168A2CBI	CBI_Contains facility comments on draft report for site visit to Hill Air Force Base from Caroline LeClair and Barbara Hall	Report	Hill Air Force Base	04/27/2017	HAFB. 2017. CBI_Facility Comments on Draft Metal Finishing Site Visit Report for Hill Air Force Base from Caroline LeClair and Barbara Hall.	Metal Finishing, Part 433	25	Yes	No	MF00168A2
10.31	EPA-HQ-OW-2015-0665-1069.3	CBI_P2 Assessment of Building 505 - DCN MF00168A3CBI	CBI_Provides a pollution prevention (P2) assessment for building 505 at Hill Air Force Base.	Report	Hill Air Force Base	04/27/2017	HAFB. 2017. CBI_P2 Assessment of Building 505.	Metal Finishing, Part 433	20	Yes	No	MF00168A3
10.31	EPA-HQ-OW-2015-0665-1069.4	CBI_Industrial Waste Collection System (IWCS) Discharges from Hill Air Force Base - DCN MF00168A4CBI	CBI_Report that quantifies the amount of waste discharged to the industrial waste collection system (IWCS) at Hill Air Force Base	Report	Hill Air Force Base	03/31/2017	HAFB. 2017. CBI_Industrial Waste Collection System (IWCS) Discharges from Hill Air Force Base.	Metal Finishing, Part 433	726	Yes	No	MF00168A4

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10.31	EPA-HQ-OW-2015-0665-0797	NAICS Association Webpage - DCN MF00169	NAICS Webpage	Data	NAICS	01/01/2015	NAICS. 2015. NAICS Association Webpage. Accessed: December 30, 2015.	Metal Finishing, Part 433	4	No	No	MF00169
10.31	EPA-HQ-OW-2015-0665-1075	CBI_Facility Comments on Draft Metal Finishing Hill Air Foorce Base Site Visit Report - Second Round - DCN MF00170CBI	CBI_Second round of facility comments on draft report (D3) for EPA's site visit to Hill Air Force Base.	Report	Hill Air Force Base	07/26/2017	HAFB. 2017. CBI_Facility Comments on Draft Metal Finishing Hill Air Foorce Base Site Visit Report - Second Round.	Metal Finishing, Part 433	28	Yes	No	MF00170
10.31	EPA-HQ-OW-2015-0665-1070	CBI_Facility Comments on Draft Metal Finishing Site Visit Report for Pilkington Metal Finishing LLC - DCN MF00171CBI	CBI_Contains facility comments on draft report for site visit to Pilkington Metal Finishing	Report	Pilkington	05/22/2017	Pilkington. 2017. Facility Comments on Draft Metal Finishing Site Visit Report for Pilkington Metal Finishing LLC.	Metal Finishing, Part 433	29	Yes	No	MF00171

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10.31	EPA-HQ-OW-2015-0665-1070.1	CBI_Cover Letter for Pilkington Metal Finishing LLC Draft Site Visit Report Comments - DCN MF00171A1CBI	CBI_Cover letter explaining the comments Pilkington made in the draft site visit report.	Memorandum	Pilkington	05/12/2017	Pilkington. 2017. Cover Letter for Pilkington Metal Finishing LLC Draft Site Visit Report Comments.	Metal Finishing, Part 433	1	Yes	No	MF00171A1
10.31	EPA-HQ-OW-2015-0665-1070.2	CBI_Wastewater Treatment System Costs at Pilkington Metal Finishing LLC - DCN MF00171A2CBI	CBI_Provides a list of operating and maintenance cost and capital replacement costs for the wastewater treatment system at Pilkington.	Data	Pilkington	05/22/2017	Pilkington. 2017. Wastewater Treatment System Costs at Pilkington Metal Finishing LLC.	Metal Finishing, Part 433	0	Yes	No	MF00171A2
10.31	EPA-HQ-OW-2015-0665-1070.3	CBI_SDSs for Pilkington Metal Finishing LLC - DCN MF00171A3CBI	CBI_Provides the SDS's for 57 chemicals used at Pilkington Metal Finishing LLC.	Data	Pilkington	05/22/2017	Pilkington. 2017. SDSs for Pilkington Metal Finishing LLC.	Metal Finishing, Part 433	0	Yes	No	MF00171A3

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10.31	EPA-HQ-OW-2015-0665-1071	CBI_Telecon with OC Tanner Comments on the Draft Site Visit Report - DCN MF00172CBI	CBI_Contains facility comments on draft report for site visit to O.C. Tanner Manufacturing Company	Meeting Materials	O.C. Tanner	04/17/2017	O.C. Tanner. 2017. CBI_Telecon with OC Tanner Comments on the Draft Site Visit Report.	Metal Finishing, Part 433	2	Yes	No	MF00172
10.31	EPA-HQ-OW-2015-0665-1071.1	CBI_Notes on the Draft OC Tanner Site Visit Report According to Telephone Conversation - DCN MF00172A1CBI	CBI_Provides the draft OC Tanner Site Visit Report that was sent to the facility with comments and updates that were relayed over a phone conversation with Annette George of OC Tanner.	Memorandum	O.C. Tanner	04/17/2017	O.C. Tanner. 2017. CBI_Notes on the Draft OC Tanner Site Visit Report According to Telephone Conversation.	Metal Finishing, Part 433	22	Yes	No	MF00172A1
10.31	EPA-HQ-OW-2015-0665-1072	Facility Comments on Draft Metal Finishing Site Visit Report for Varian Medical Systems X-Ray Products - DCN MF00173	Contains facility comments on draft report for site visit to Varian Medical Systems X-Ray Products	Report	Varian	03/28/2017	Varian. 2017. Facility Comments on Draft Metal Finishing Site Visit Report for Varian Medical Systems X-Ray Products.	Metal Finishing, Part 433	12	No	No	MF00173

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10.31	EPA-HQ-OW-2015-0665-1072.1	Email from Jason Kyle to Molly McEvoy. Subject: FW: MF Deliverable: Varian Medical Systems X-Ray Products Draft Site Visit Report for Visit in July 2016 - DCN MF00173A1	Email from Jason Kyle indicating that the report is no longer CBI.	Email	Varian	04/04/2017	Varian. 2017. Email from Jason Kyle to Molly McEvoy. Subject: Varian Medical Systems X-Ray Products Draft SVR for Visit in July 2016.	Metal Finishing, Part 433	5	No	No	MF00173A1
10.31	EPA-HQ-OW-2015-0665-1073	Facility Comments on Draft Metal Finishing Site Visit Report for Plymouth Plating Works - DCN MF00174	Telecon contains facility comments on draft report for site visit to Plymouth Plating Works provided over the phone on May 11, 2017.	Report	Plymouth Plating	05/11/2017	Plymouth Plating. 2017. Facility Comments on Draft Metal Finishing Site Visit Report for Plymouth Plating Works.	Metal Finishing, Part 433	1	No	No	MF00174
10.31	EPA-HQ-OW-2015-0665-1074	CBI_Facility Comments on Draft Metal Finishing Site Visit Report for KC Jones Plating Company - DCN MF00175CBI	CBI_Contains facility comments on draft report for site visit to KC Jones Plating Company	Report	KC Jones	02/28/2017	KC Jones. 2017. CBI_Facility Comments on Draft Metal Finishing Site Visit Report for KC Jones Plating Company.	Metal Finishing, Part 433	22	Yes	No	MF00175

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10.31	EPA-HQ-OW-2015-0665-1074.1	CBI_Cover Letter for KC Jones Plating Company Draft Site Visit Report Comments - DCN MF00175A1CBI	CBI_Cover letter explaining the comments KC Jones made in the draft site visit report.	Report	KC Jones	03/23/2017	KC Jones. 2017. CBI_Cover Letter for KC Jones Plating Company Draft Site Visit Report Comments.	Metal Finishing, Part 433	6	Yes	No	MF00175A1
10.31	EPA-HQ-OW-2015-0665-1074.2	Emails from KC Jones with Comments on KC Jones Plating Company Site Visit Report - DCN MF00175A2	Email documentation of KC Jones Plating Company Comment on the draft site visit report.	Email	KC Jones	03/28/2017	KC Jones. 2017. Emails from KC Jones with Comments on KC Jones Plating Company Site Visit Report.	Metal Finishing, Part 433	3	No	No	MF00175A2
10.31	EPA-HQ-OW-2015-0665-1074.3	CBI_CBI Claims from KC Jones for Site Visit Report - DCN MF00175A3CBI	CBI_Letter from KC Jones Plating Company containing CBI claims for the KC Jones Site Visit Report	Report	KC Jones	05/30/2017	KC Jones. 2017. CBI_CBI Claims from KC Jones for Site Visit Report.	Metal Finishing, Part 433	1	Yes	No	MF00175A3

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10.31	EPA-HQ-OW-2015-0665-1076	CBI_Facility Comments on Draft Metal Finishing Site Visit Report for AJAX Metal Processing - DCN MF00176CBI	CBI_Contains facility comments on draft report for site visit to AJAX Metal Processing	Report	AJAX Metal	01/27/2017	AJAX Metal. 2017. CBI_Facility Comments on Draft Metal Finishing Site Visit Report for AJAX Metal Processing.	Metal Finishing, Part 433	14	Yes	No	MF00176
10.31	EPA-HQ-OW-2015-0665-1076.1	CBI_AJAX Facility Comments on Sit Visit Report Cover Letter - DCN MF00176.A1	CBI_Contains cover letter for facility comments on the draft report for site visit to AJAX Metal Processing. Also includes additional information requested by EPA and ERG, such as costs and plating rates.	Data	Frank Buono	04/04/2017	Buono, F. 2017. CBI_AJAX Facility Comments on Site Visit Report Cover Letter.	Metal Finishing, Part 433	4	Yes	No	MF00176A1
10.31	EPA-HQ-OW-2015-0665-1076.2	CBI_SDSs for AJAX Metal Processing - DCN MF00176.A2	Contains two SDSs for AJAX Metal Processing.	Data	AJAX Metal Processing	04/04/2017	AJAX Metal. 2017. CBI_SDSs for AJAX Metal Processing.	Metal Finishing, Part 433	22	Yes	No	MF00176A2

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10.31	EPA-HQ-OW-2015-0665-1077	CBI_Facility Comments on Draft Metal Finishing Site Visit Report for Ford Flat Rock - DCN MF00177CBI	CBI_Contains facility comments on draft report for site visit to Ford Flat Rock	Report	Ford Flat Rock	04/20/2017	Ford Flat Rock. 2017. CBI_Facility Comments on Draft Metal Finishing Site Visit Report for Ford Flat Rock.	Metal Finishing, Part 433	14	Yes	No	MF00177
10.31	EPA-HQ-OW-2015-0665-1077.1	CBI_Ford Flat Rock Industrial Pretreatment Report - DCN MF00177.A1CBI	CBI_Containd Industrial Pretreatment Report for Ford Flat Rock	Memorandum	Ford Flat Rock	04/21/2017	Ford Flat Rock. 2017. CBI_Ford Flat Rock Industrial Pretreatment Report.	Metal Finishing, Part 433	57	Yes	No	MF00177A1
10.31	EPA-HQ-OW-2015-0665-1077.2	CBI_Safety Data Sheets - DCN MF00177.A2CBI	CBI_Safety Data Sheet for Ford Flat Rock plating chemicals.	Memorandum	Ford Flat Rock	04/22/2017	Ford Flat Rock. 2017. CBI_Safety Data Sheets.	Metal Finishing, Part 433	87	Yes	No	MF00177A2

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10.31	EPA-HQ-OW-2015-0665-1078	CBI_Facility Comments on Draft Metal Finishing Site Visit Report for Elm Plating - DCN MF00178CBI	CBI_Contains facility comments on draft report for site visit to Elm Plating and additional information submitted by the facility.	Report	Elm Plating	04/21/2017	Elm Plating. 2017. CBI_Facility Comments on Draft Metal Finishing Site Visit Report for Elm Plating.	Metal Finishing, Part 433	3	Yes	No	MF00178
10.31	EPA-HQ-OW-2015-0665-1078.1	CBI_Draft Report Comments - DCN MF00178.A1CBI	CBI_Facility comments to the Draft Site Visit Report for the site visit to Elm Plating on August 17, 2016.	Report	Elm Plating	04/21/2017	Elm Plating. 2017. CBI_Draft Report Comments.	Metal Finishing, Part 433	4	Yes	No	MF00178A1
10.31	EPA-HQ-OW-2015-0665-1078.2	CBI_Discharge Monitoring Analytical Report - DCN MF00178.A2CBI	CBI_Contains discharge monitoring analytical reports for Elm Plating.	Data	Elm Plating	04/21/2017	Elm Plating. 2017. CBI_Discharge Monitoring Analytical Report.	Metal Finishing, Part 433	31	Yes	No	MF00178A2

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10.31	EPA-HQ-OW-2015-0665-1078.3	CBI_Operating Costs - DCN MF00178.A3CBI	CBI_Contains Operating costs for the Elm Plating industrial wastewater pretreatment system.	Data	Elm Plating	04/21/2017	Elm Plating. 2017. CBI_Operating Costs.	Metal Finishing, Part 433	2	Yes	No	MF00178A3
10.31	EPA-HQ-OW-2015-0665-1078.4	CBI_SDS for Substances Entering Treatment - DCN MF00178.A4CBI	CBI_Contains Safety Data Sheets for chemical entering the Elm Plating industrial wastewater pretreatment system.	Data	Elm Plating	04/21/2017	Elm Plating. 2017. CBI_SDS for Substances Entering Treatment.	Metal Finishing, Part 433	201	Yes	No	MF00178A4
10.31	EPA-HQ-OW-2015-0665-1034	Facility Comments on Draft Metal Finishing Site Visit Report for Trion Coatings - DCN MF00179	Contains facility comments on draft report for site visit to Trion Coatings	Report	Trion Coatings	03/20/2017	Trion Coatings. 2017. Facility Comments on Draft Metal Finishing Site Visit Report for Trion Coatings.	Metal Finishing, Part 433	4	No	No	MF00179

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10.31	EPA-HQ-OW-2015-0665-1034.1	Email from Trion Coatings with Comments on KC Jones Plating Company - DCN MF00179A1	Email documentation of Trion Coatings comments on the draft site visit report.	Email	Doug Morrison, IonicLiquid TrionCoating	03/20/2017	Trion Coatings. 2017. Email from Trion Coatings with Comments on KC Jones Plating Company.	Metal Finishing, Part 433	2	No	No	MF00179A1
10.31	EPA-HQ-OW-2015-0665-1079	CBI_Facility Comments on Draft Metal Finishing Site Visit Report for Methode Electronics, Inc. - DCN MF00180CBI	CBI_Contains facility comments on draft report for site visit to Methode Electronics, Inc.	Report	Methode	05/01/2017	Methode. 2017. CBI_Facility Comments on Draft Metal Finishing Site Visit Report for Methode Electronics, Inc..	Metal Finishing, Part 433	26	Yes	No	MF00180
10.31	EPA-HQ-OW-2015-0665-0990	Facility Comments on Draft Metal Finishing Site Visit Report for Eagle Electronics - DCN MF00181	Contains facility comments on the draft report for the site visit to Eagle Electronics on August 18, 2016.	Report	Eagle Electronics	04/17/2017	Eagle Electronics. 2017. Facility Comments on Draft Metal Finishing Site Visit Report for Eagle Electronics.	Metal Finishing, Part 433	3	No	No	MF00181

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10.31	EPA-HQ-OW-2015-0665-0991	CBI_Facility Comments on Draft Metal Finishing Site Visit Report for Metal Impact LLC - DCN MF00182	CBI_Contains facility comments on draft report for site visit to Metal Impact LLC	Report	Metal Impact LLC	03/17/2017	Metal Impact LLC. 2017. CBI_Facility Comments on Draft Metal Finishing Site Visit Report for Metal Impact LLC.	Metal Finishing, Part 433	16	Yes	No	MF00182
10.31	EPA-HQ-OW-2015-0665-0992	CBI_Facility Comments on Draft Metal Finishing Site Visit Report for Magnetic Inspection Laboratory - DCN MF00183	CBI_Contains facility comments on draft report for site visit to Magnetic Inspection Laboratory	Memorandum	MIL	03/24/2017	MIL. 2017. CBI_Facility Comments on Draft Metal Finishing Site Visit Report for Magnetic Inspection Laboratory.	Metal Finishing, Part 433	16	Yes	No	MF00183
10.31	EPA-HQ-OW-2015-0665-0993	Sanitized_Final Metal Finishing Site Visit Report for Hill Air Force Base - DCN MF00184	Final sanitized site visit report prepared by ERG from the site visit at Hill Air Force Base on July 11, 2016.	Report	U.S. EPA	08/24/2017	U.S. EPA. 2017. Sanitized Final Metal Finishing Site Visit Report for Hill Air Force Base.	Metal Finishing, Part 433	13	No	No	MF00184

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10.31	EPA-HQ-OW-2015-0665-0994	Sanitized_Final Metal Finishing Site Visit Report for Williams International - DCN MF00185	Final sanitized site visit report prepared by ERG from the site visit at Williams International on July 12, 2016.	Report	U.S. EPA	07/31/2017	U.S. EPA. 2017. Sanitized Final Metal Finishing Site Visit Report for Williams International.	Metal Finishing, Part 433	4	No	No	MF00185
10.31	EPA-HQ-OW-2015-0665-0995	Sanitized_Final Metal Finishing Site Visit Report for Blanchard Metal Processing - DCN MF00186	Final sanitized site visit report prepared by ERG from the site visit at Blanchard Metal Processing on July 13, 2016.	Report	U.S. EPA	01/12/2017	U.S. EPA. 2017. Sanitized Final Metal Finishing Site Visit Report for Blanchard Metal Processing.	Metal Finishing, Part 433	4	No	No	MF00186
10.31	EPA-HQ-OW-2015-0665-0996	Sanitized_Final Metal Finishing Site Visit Report for Pilkington Metal Finishing LLC - DCN MF00187	Final sanitized site visit report prepared by ERG from the site visit at Pilkington Metal Finishing LLC on July 13, 2016.	Report	U.S. EPA	05/30/2017	U.S. EPA. 2017. Sanitized Final Metal Finishing Site Visit Report for Pilkington Metal Finishing LLC.	Metal Finishing, Part 433	25	No	No	MF00187

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10.31	EPA-HQ-OW-2015-0665-0997	Sanitized_Final Metal Finishing Site Visit Report for O.C. Tanner Manufacturing Company - DCN MF00188	Final sanitized site visit report prepared by ERG from the site visit at O.C. Tanner Manufacturing Company on July 14, 2016.	Report	U.S. EPA	06/21/2017	U.S. EPA. 2017. Sanitized Final Metal Finishing Site Visit Report for O.C. Tanner Manufacturing Company.	Metal Finishing, Part 433	13	No	No	MF00188
10.31	EPA-HQ-OW-2015-0665-1035	Sanitized_Final Metal Finishing Site Visit Report for KC Jones Plating Company - DCN MF00189	Final sanitized site visit report prepared by ERG from the site visit at KC Jones Plating Company on August 15, 2016.	Report	U.S. EPA	07/14/2017	U.S. EPA. 2017. Sanitized Final Metal Finishing Site Visit Report for KC Jones Plating Company.	Metal Finishing, Part 433	9	No	No	MF00189
10.31	EPA-HQ-OW-2015-0665-1036	Sanitized_Final Metal Finishing Site Visit Report for AJAX Metal Processing - DCN MF00190	Final sanitized site visit report prepared by ERG from the site visit at AJAX Metal Processing on August 16, 2016.	Report	U.S. EPA	07/14/2017	U.S. EPA. 2017. Sanitized Final Metal Finishing Site Visit Report for AJAX Metal Processing.	Metal Finishing, Part 433	7	No	No	MF00190

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10.31	EPA-HQ-OW-2015-0665-1037	Sanitized_Final Metal Finishing Site Visit Report for Ford Flat Rock - DCN MF00191	Final sanitized site visit report prepared by ERG from the site visit at Ford Flat Rock on August 16, 2016.	Report	U.S. EPA	07/14/2017	U.S. EPA. 2017. Sanitized Final Metal Finishing Site Visit Report for Ford Flat Rock.	Metal Finishing, Part 433	11	No	No	MF00191
10.31	EPA-HQ-OW-2015-0665-0798	Occupational Safety & Health Administration. Standard Industrial Classification (SIC) System Search - DCN MF00193	OSHA SIC system search.	Data	OSHA	12/11/2015	OSHA. 2015. Occupational Safety & Health Administration. Standard Industrial Classification (SIC) System Search. Accessed: December 11, 2015.	Metal Finishing, Part 433	1	No	No	MF00193
10.31	EPA-HQ-OW-2015-0665-1038	Sanitized_Final Metal Finishing Site Visit Report for Magnetic Inspection Laboratory - DCN MF00195	Final sanitized site visit report prepared by ERG from the site visit at Magnetic Inspection Laboratory on August 19, 2016.	Report	U.S. EPA	07/10/2017	U.S. EPA. 2017. Sanitized Final Metal Finishing Site Visit Report for Magnetic Inspection Laboratory Inc.	Metal Finishing, Part 433	16	No	No	MF00195

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10.31	EPA-HQ-OW-2015-0665-0799	Sanitized_Final Metal Finishing Site Visit Report for Metal Impact LLC - DCN MF00196	Final sanitized site visit report prepared by ERG from the site visit at Metal Impact on August 19, 2016.	Report	U.S. EPA	05/24/2017	U.S. EPA. 2017. Sanitized Final Metal Finishing Site Visit Report for Metal Impact LLC.	Metal Finishing, Part 433	11	No	No	MF00196
10.31	EPA-HQ-OW-2015-0665-1039	CBI_Carlisle Waste Process Flow Diagram - DCN MF00197CBI	CBI_Provides the Carlisle, El Segundo Wastewater Treatment Diagram that is presented in the final site visit report.	Data	Carlisle	08/23/2016	Carlisle. 2016. Carlisle Waste Process Flow Diagram.	Metal Finishing, Part 433	3	Yes	No	MF00197
10.31	EPA-HQ-OW-2015-0665-1040	Northrop Grumman Building D1 Plating Shop Chemical SDSs - DCN MF00198	Provides 8 Safety Data Sheets (SDSs) used in Northrop Grumman's Building D1	Data	Northrop Grumman	10/26/2016	Northrop Grunman. 2016. Northrop Grumman Building D1 Plating Shop Chemical SDSs.	Metal Finishing, Part 433	44	No	No	MF00198

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10.31	EPA-HQ-OW-2015-0665-0998	Northrop Grumman Building M3 Plating Shop Chemical SDSs - DCN MF00199	Provides 56 Safety Data Sheets (SDSs) used in Northrop Grumman's Building M3	Data	Northrop Grumman	10/26/2016	Northrop Grunman. 2016. Northrop Grumman Building M3 Plating Shop Chemical SDSs.	Metal Finishing, Part 433	298	No	No	MF00199
10.31	EPA-HQ-OW-2015-0665-0999	Northrop Grumman Industrial Wastewater Self Monitoring Report for Building D1 - DCN MF00200	Provides monitoring data from 10/1/2015 to 12/31/2015 for Northrop Grumman in Manhattan Beach, California. Self monitoring report is a part of Northrop Grumman's permit.	Data	LA Sanitation District	01/15/2016	LA Sanitation District. 2016. Northrop Grumman Industrial Wastewater Self Monitoring Report for Building D1.	Metal Finishing, Part 433	24	No	No	MF00200
10.31	EPA-HQ-OW-2015-0665-0999.1	Northrop Grumman Industrial Wastewater Permit Data Sheet for Building D1 - DCN MF00200A1	Permit data sheet for Northrop Grumman's Building D1 in Manhattan Beach, California. Provides sample points and federal regulation information for each segregated waste stream. Also provides parameter, frequency, method, and units for samples required by their permit.	Permit, Registration	LA Sanitation District	03/08/2016	LA Sanitation District. 2016. Northrop Grumman Industrial Wastewater Permit Data Sheet for Building D1.	Metal Finishing, Part 433	10	No	No	MF00200A1

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10.31	EPA-HQ-OW-2015-0665-1000	Northrop Grumman Industrial Wastewater Self Monitoring Report for Building M3 - DCN MF00201	Provides monitoring data from 10/1/2015 to 12/31/2015 for Northrop Grumman in Redondo Beach, California. Self monitoring report is a part of Northrop Grumman's permit.	Data	LA Sanitation District	01/15/2016	LA Sanitation District. 2016. Northrop Grumman Industrial Wastewater Self Monitoring Report for Building M3.	Metal Finishing, Part 433	16	No	No	MF00201
10.31	EPA-HQ-OW-2015-0665-1000.1	Northrop Grumman Industrial Wastewater Permit Data Sheet for Building M3 - DCN MF00201A1	Permit data sheet for Northrop Grumman's Building M3 in Manhattan Beach, California. Provides sample points and federal regulation information for each segregated waste stream. Also provides parameter, frequency, method, and units for samples required by	Permit, Registration	LA Sanitation District	01/13/2016	LA Sanitation District. 2016. Northrop Grumman Industrial Wastewater Permit Data Sheet for Building M3.	Metal Finishing, Part 433	10	No	No	MF00201A1
10.31	EPA-HQ-OW-2015-0665-1001	Northrop Grumman's Building M3 Wastewater Treatment Flow Diagram - DCN MF00202	Provides process flow diagram for Northrop Grumman's Building M3 wastewater treatment system in Manhattan Beach, California.	Data	Northrop Grumman	10/26/2016	Northrop Grunman. 2016. Northrop Grumman's Building M3 Wastewater Treatment Flow Diagram	Metal Finishing, Part 433	1	No	No	MF00202

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10.31	EPA-HQ-OW-2015-0665-1001.1	Northrop Grumman Map of Buildings in California - DCN MF00202A1	Provides an overhead view of Northrop Grumman's buildings in California.	Data	Northrop Grumman	05/03/2004	Northrop Grunman. 2004. Northrop Grumman Map of Buildings in California.	Metal Finishing, Part 433	1	No	No	MF00202A1
10.31	EPA-HQ-OW-2015-0665-1002	Email Correspondence with Northrop Grumman - DCN MF00203	Provides several emails between Northrop Grumman's Mark Bordelon and Ahmar Siddiqui, EPA.	Email	Northrop Grumman	07/08/2016	Northrop Grunman. 2016. Email Correspondence with Northrop Grumman.	Metal Finishing, Part 433	5	No	No	MF00203
10.31	EPA-HQ-OW-2015-0665-1003	CBI_Wastewater Treatment Flow Diagram for PB Fasteners and Nondisclosure Agreement - DCN MF00204CBI	CBI_Provides signed visitor nondisclosure agreement for ERG and wastewater treatment diagrams for PB Fasteners	Data	PB Fasteners	05/17/2016	PB Fasteners. 2016. Wastewater Treatment Flow Diagram for PB Fasteners and Nondisclosure Agreement.	Metal Finishing, Part 433	6	Yes	No	MF00204

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10.31	EPA-HQ-OW-2015-0665-1041	CBI_Industrial Discharge Permit for Hill Air Force Base - DCN MF00205CBI	CBI_Provides industrial discharge permit specification for Hill Air Force, such as effluent limitations, reporting requirements, and sampling specifications.	Permit, Registration	North Davis Sewer	08/01/2014	North Davis Sewer. 2014. CBI_Industrial Discharge Permit for Hill Air Force Base.	Metal Finishing, Part 433	23	Yes	No	MF00205
10.31	EPA-HQ-OW-2015-0665-1041.1	CBI_Analytical Data Reports for Permit Monitoring at Hill Air Force - DCN MF00205A1CBI	CBI_Contains 2014 through 2016 data on permit sampling data collected at various sample points at Hill Air Force Base.	Data	Stantec Consulting, Inc.	08/29/2016	Stantec Consulting, Inc.. 2016. CBI_Analytical Data Reports for Permit Monitoring at Hill Air Force.	Metal Finishing, Part 433	1714	Yes	No	MF00205A1
10.31	EPA-HQ-OW-2015-0665-1041.2	CBI_Analytical Data Spreadsheet for Permit Monitoring at Hill Air Force - DCN MF00205A2CBI	CBI_Contains 2003 through 2016 data on permit sampling data collected from the industrial wastewater treatment plant sampling point for Al, As, Cd, Cr, Cu, CN, Pb, Hg, Mo, Ni, Se, Ag, Zn, TTO, pH, TSS, O&G, BOD, COD, and PCB.	Data	Hill Air Force Base	08/31/2016	Hill Air Force Base. 2016. CBI_Analytical Data Spreadsheet for Permit Monitoring at Hill Air Force.	Metal Finishing, Part 433		Yes	No	MF00205A2

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10.31	EPA-HQ-OW-2015-0665-1042	CBI_Process Details, Wastewater Generation, and Analytical Data for Building 505 and 507 at Hill Air Force Base - DCN MF00206CBI	CBI_Provides each process schematic at Hill Air Force Building 505 and 507 and describes that type of process, chemicals, wastewater generation, and analytical data sample results.	Data	Hill Air Force Base	08/29/2016	Hill Air Force Base. 2016. CBI_Process Details, Wastewater Generation, and Analytical Data for Building 505 and 507 at Hill Air Force Base.	Metal Finishing, Part 433	90	Yes	No	MF00206
10.31	EPA-HQ-OW-2015-0665-1043	CBI_SDSs for Hill Air Force Base - DCN MF00207CBI	CBI_Contains 6 SDSs for Zinc Nickel Plating and Chromate Conversion Coating chemicals	Data	Dipsol of America, Inc.	08/29/2016	Dipsol of America, Inc.. 2016. CBI_SDSs for Hill Air Force Base.	Metal Finishing, Part 433	37	Yes	No	MF00207
10.31	EPA-HQ-OW-2015-0665-1044	CBI_Email Correspondence with Hill Air Force Base - DCN MF00208CBI	Email correspondence between Ahmar Siddiqui and Barbara Hall about additional information Hill Air Force Base provided to supplement the site visit report.	Email	HAFB	08/26/2016	HAFB. 2016. CBI_Email Correspondence with Hill Air Force Base.	Metal Finishing, Part 433	5	Yes	No	MF00208

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10.31	EPA-HQ-OW-2015-0665-1045	Industrial Wastewater Discharge Permit for Williams International - DCN MF00209	Provides effluent limitations, monitoring/reporting requirements, and other conditions required by Williams International's Industrial Wastewater Discharge Permit.	Permit, Registration	Central Weber Sewer	12/11/2012	Central Weber Sewer. 2012. Industrial Wastewater Discharge Permit for Williams International.	Metal Finishing, Part 433	17	No	No	MF00209
10.31	EPA-HQ-OW-2015-0665-1046	Wastewater Treatment System Photos at Blanchard Metal Processing - DCN MF00210	Andra Ahrens, Salt Lake City Pretreatment Coordinator, provided ERG with photos of the wastewater treatment system because it was enclosed and the tanks were not visible during the site visit.	Data	Blanchard	04/12/2012	Blanchard. 2012. Wastewater Treatment System Photos at Blanchard Metal Processing.	Metal Finishing, Part 433	4	No	No	MF00210
10.31	EPA-HQ-OW-2015-0665-1046.1	Blanchard Metal Processing Plant Layout - DCN MF00210A1	Provides an aerial view of the Blanchard Metal Processing plant included tanks, floor drains, direct drain of non-contact water, and raised floor drains.	Data	Blanchard	03/17/2008	Blanchard. 2008. Blanchard Metal Processing Plant Layout.	Metal Finishing, Part 433	1	No	No	MF00210A1

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10.31	EPA-HQ-OW-2015-0665-1047	Industrial Wastewater Discharge Permit for Blanchard Metal Processing - DCN MF00211	Provides effluent limitations, monitoring/reporting requirements, and other conditions required Blanchard Metal Processing's Industrial Wastewater Discharge Permit.	Permit, Registration	SLC Reclamation Plant	12/15/2014	SLC Reclamation Plant. 2014. Industrial Wastewater Discharge Permit for Blanchard Metal Processing.	Metal Finishing, Part 433	43	No	No	MF00211
10.31	EPA-HQ-OW-2015-0665-1047.1	Wastewater Discharge Permit Application and Baseline Monitoring Report at Blanchard Metal Processing - DCN MF00211A1	Application for Blanchard Metal Processing's industrial wastewater discharge permit.	Permit, Registration	Salt Lake Water	12/14/2012	Salt Lake Water. 2012. Wastewater Discharge Permit Application and Baseline Monitoring Report at Blanchard Metal Processing.	Metal Finishing, Part 433	20	No	No	MF00211A1
10.31	EPA-HQ-OW-2015-0665-1047.2	Annual Pretreatment Inspection for Blanchard Metal Processing - DCN MF00211A2	Contains annual pretreatment inspection of water usage, wastewater handling, chemical and waste production, self-monitoring, and other permit specifications.	Report	Karl Hartman	01/15/2015	Hartman, K. 2015. Annual Pretreatment Inspection for Blanchard Metal Processing.	Metal Finishing, Part 433	18	No	No	MF00211A2

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10.31	EPA-HQ-OW-2015-0665-1047.3	Verification for Applicable Standards for Blanchard Metal Processing - DCN MF00211A3	Checklist to determine whether Blanchard Metal Processing should still be regulated under 40 CFR 413 (Electroplating) instead of 40 CFR 433 (Metal Finishing).	Report	Salt Lake Water	02/11/2014	Salt Lake Water. 2014. Verification for Applicable Standards for Blanchard Metal Processing.	Metal Finishing, Part 433	3	No	No	MF00211A3
10.31	EPA-HQ-OW-2015-0665-1047.4	Request for an Alternative to Sampling for the Full List of TTO at Blanchard Metal Processing - DCN MF00211A4	Provides sampling results for May 2011 at Blanchard Metal Processing for TTO. This was sent to the pretreatment coordinator.	Memorandum	Blanchard	06/13/2011	Blanchard. 2011. Request for an Alternative to Sampling for the Full List of TTO at Blanchard Metal Processing.	Metal Finishing, Part 433	8	No	No	MF00211A4
10.31	EPA-HQ-OW-2015-0665-1048	Sampling Results for Blanchard Metal Processing - DCN MF00212	Provides sample concentrations for Blanchard Metal Processing from September 2008 through March 2016. Contains sample results for Cd, Cr, Cu, Pb, Ni, pH, Ag, Zn, CN, and total metals.	Data	Blanchard	07/06/2016	Blanchard. 2016. Sampling Results for Blanchard Metal Processing.	Metal Finishing, Part 433		No	No	MF00212

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10.31	EPA-HQ-OW-2015-0665-1004	CBI_Anodize, Dye, and Seal SDSs for Pilkington Metal Finishing - DCN MF00213CBI	CBI_Contains 21 SDSs for anodizing, dye, and seal chemicals used at Pilkington Metal Finishing	Data	Pilkington	07/13/2016	Pilkington. 2016. Anodize, Dye, and Seal SDSs for Pilkington Metal Finishing.	Metal Finishing, Part 433	155	Yes	No	MF00213
10.31	EPA-HQ-OW-2015-0665-1004.1	CBI_Cleaning and Etching SDSs for Pilkington Metal Finishing - DCN MF00213A1CBI	CBI_Contains 11 SDSs for cleaning and etching chemicals used at Pilkington Metal Finishing	Data	Pilkington	07/13/2016	Pilkington. 2016. Cleaning and Etching SDSs for Pilkington Metal Finishing.	Metal Finishing, Part 433	78	Yes	No	MF00213A1
10.31	EPA-HQ-OW-2015-0665-1004.2	CBI_Conversion Coating SDSs for Pilkington Metal Finishing - DCN MF00213A2CBI	CBI_Contains 7 SDSs for conversion coating chemicals used at Pilkington Metal Finishing	Data	Pilkington	07/13/2016	Pilkington. 2016. Conversion Coating SDSs for Pilkington Metal Finishing.	Metal Finishing, Part 433	40	Yes	No	MF00213A2

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10.31	EPA-HQ-OW-2015-0665-1004.3	CBI_Electropolish, Passivation, and Heat Treat SDSs for Pilkington Metal Finishing - DCN MF00213A3CBI	CBI_Contains 4 SDSs for electropolish, passivation, and heat treat chemicals used at Pilkington Metal Finishing	Data	Pilkington	07/13/2016	Pilkington. 2016. Electropolish, Passivation, and Heat Treat SDSs for Pilkington Metal Finishing.	Metal Finishing, Part 433	20	Yes	No	MF00213A3
10.31	EPA-HQ-OW-2015-0665-1004.4	CBI_Refurbishment SDSs for Pilkington Metal Finishing - DCN MF00213A4CBI	CBI_Contains 7 SDSs for refurbishment chemicals used at Pilkington Metal Finishing	Data	Pilkington	07/13/2016	Pilkington. 2016. Refurbishment SDSs for Pilkington Metal Finishing.	Metal Finishing, Part 433	43	Yes	No	MF00213A4
10.31	EPA-HQ-OW-2015-0665-1004.5	CBI_Wastewater Treatment SDSs for Pilkington Metal Finishing - DCN MF00213A5CBI	CBI_Contains 7 SDSs for wastewater treatment chemicals used at Pilkington Metal Finishing	Data	Pilkington	07/13/2016	Pilkington. 2016. Wastewater Treatment SDSs for Pilkington Metal Finishing.	Metal Finishing, Part 433	46	Yes	No	MF00213A5

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10.31	EPA-HQ-OW-2015-0665-1080	CBI_Building 1 Tank Diagram for Pilkington Metal Finishing - DCN MF00214CBI	CBI_Tank diagram of process line in building 1 with numbered tanks corresponding to chemical processing tank contents.	Data	Pilkington	07/13/2016	Pilkington. 2016. Building 2 Tank Diagram for Pilkington Metal Finishing.	Metal Finishing, Part 433	1	Yes	No	MF00214
10.31	EPA-HQ-OW-2015-0665-1080.1	CBI_Building 2 Tank Diagram for Pilkington Metal Finishing - DCN MF00214A1CBI	CBI_Tank diagram of process line in building 2 with numbered tanks corresponding to chemical processing tank contents.	Data	Pilkington	07/13/2016	Pilkington. 2016. Building 1 Tank Diagram for Pilkington Metal Finishing.	Metal Finishing, Part 433	1	Yes	No	MF00214A1
10.31	EPA-HQ-OW-2015-0665-1080.2	CBI_Building 3 Tank Diagram for Pilkington Metal Finishing - DCN MF00214A2CBI	CBI_Tank diagram of process line in building 3 with numbered tanks corresponding to chemical processing tank contents.	Data	Pilkington	07/13/2016	Pilkington. 2016. Building 3 Tank Diagram for Pilkington Metal Finishing.	Metal Finishing, Part 433	1	Yes	No	MF00214A2

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10.31	EPA-HQ-OW-2015-0665-1080.3	CBI_Chemical Processing Flow Charts for Pilkington Metal Finishing - DCN MF00214A3CBI	CBI_Contains process flows for all three buildings at Pilkington Metal Finishing. The process flows are organized by anodizing/conversion coating, electropolishing, passivating, acid cleaning, degreasing, paint stripping, and deoxidizing.	Data	Pilkington	07/13/2016	Pilkington. 2016. Chemical Processing Flow Charts for Pilkington Metal Finishing.	Metal Finishing, Part 433	1	Yes	No	MF00214A3
10.31	EPA-HQ-OW-2015-0665-1080.4	CBI_Chemical Processing Tank Contents for Pilkington Metal Finishing - DCN MF00214A4CBI	CBI_Provides the volume, solution identification, and solution name in each for the numbered tanks in the Building 1, 2, and 3 diagrams.	Data	Pilkington	07/13/2016	Pilkington. 2016. Chemical Processing Tank Contents for Pilkington Metal Finishing.	Metal Finishing, Part 433	2	Yes	No	MF00214A4
10.31	EPA-HQ-OW-2015-0665-1080.5	Chemical Flow Streams for Pilkington Metal Finishing - DCN MF00214A5	Contains waste process flow diagrams for life cycle of chemicals and waste.	Data	Pilkington	06/21/2012	Pilkington. 2012. Chemical Flow Streams for Pilkington Metal Finishing.	Metal Finishing, Part 433	7	No	No	MF00214A5

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10.31	EPA-HQ-OW-2015-0665-1081	CBI_Wastewater Treatment Process Flow Diagram for Building 1 & 2 at Pilkington Metal Finishing - DCN MF00215CBI	CBI_Provides a general flow diagram for the wastewater generated in Buildings 1 & 2. Provides treatment, sampling, disposal, and discharge information.	Data	Pilkington	07/13/2016	Pilkington. 2016. Wastewater Treatment Process Flow Diagram for Building 1 & 2 at Pilkington Metal Finishing.	Metal Finishing, Part 433	1	Yes	No	MF00215
10.31	EPA-HQ-OW-2015-0665-1081.1	CBI_Wastewater Treatment Process Flow Diagram for Building 3 at Pilkington Metal Finishing - DCN MF00215A1CBI	CBI_Contains wastewater treatment process flow diagram for the zero liquid discharge facility in Building 3.	Data	Pilkington	07/13/2016	Pilkington. 2016. Wastewater Treatment Process Flow Diagram for Building 2 at Pilkington Metal Finishing.	Metal Finishing, Part 433	1	Yes	No	MF00215A1
10.31	EPA-HQ-OW-2015-0665-1081.2	Wastewater Process Flow Diagram for Pilkington Metal Finishing - DCN MF00215A2	Pilkington wastewater treatment diagram with sample location and process tanks that flow into the wastewater treatment for buildings 1 & 2.	Data	Pilkington	07/12/2010	Pilkington. 2010. Wastewater Process Flow Diagram for Pilkington Metal Finishing.	Metal Finishing, Part 433	2	No	No	MF00215A2

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10.31	EPA-HQ-OW-2015-0665-1082	Wastewater Discharge Permit Renewal for Pilkington Metal Finishing - DCN MF00216	Provides 2015 Wastewater Discharge Permit (SLC-0062) for Pilkington Metal Finishing	Permit, Registration	Salt Lake Water	08/24/2015	Salt Lake Water. 2015. Wastewater Discharge Permit Renewal for Pilkington Metal Finishing.	Metal Finishing, Part 433	42	No	No	MF00216
10.31	EPA-HQ-OW-2015-0665-1082.1	Wastewater Discharge Permit Application and Baseline Monitoring Report for Pilkington Metal Finishing - DCN MF00216A1	Contains Pilkington Metal Finishing's 2012 wastewater discharge permit and baseline monitoring report.	Permit, Registration	Salt Lake Water	07/20/2012	Salt Lake Water. 2012. Wastewater Discharge Permit Application and Baseline Monitoring Report for Pilkington Metal Finishing.	Metal Finishing, Part 433	72	No	No	MF00216A1
10.31	EPA-HQ-OW-2015-0665-1082.2	Annual Pretreatment Inspection for Pilkington Metal Finishing - DCN MF00216A2	Inspection report conducted at Pilkington Metal Finishing by Salt Lake City Water Reclamation Pretreatment Coordinator in 2015.	Permit, Registration	Salt Lake Water	03/23/2015	Salt Lake Water. 2015. Annual Pretreatment Inspection for Pilkington Metal Finishing.	Metal Finishing, Part 433	18	No	No	MF00216A2

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10.31	EPA-HQ-OW-2015-0665-1082.3	Toxic Organic Management Plan (TOMP) for Pilkington Metal Finishing - DCN MF00216A3	Contains the Toxic Organic Management Plan (TOMP) in lieu of sampling for TTOs under 40 CFR 433 for Pilkington Metal Finishing	Permit, Registration	Pilkington	06/20/2011	Pilkington. 2011. Toxic Organic Management Plan (TOMP) for Pilkington Metal Finishing.	Metal Finishing, Part 433	24	No	No	MF00216A3
10.31	EPA-HQ-OW-2015-0665-1083	CBI_Email from Wayne VanTassell, Pilkington Metal Finishing Containing Information EPA Requested - DCN MF00217CBI	CBI_Email from Wayne VanTassell, Pilkington Metal Finishing, which provided SDSs, wastewater treatment diagrams, and metal finishing process flow diagrams.	Email	Pilkington	09/12/2016	Pilkington. 2016. Email from Wayne VanTassell, Pilkington Metal Finishing Containing Information EPA Requested.	Metal Finishing, Part 433	2	Yes	No	MF00217
10.31	EPA-HQ-OW-2015-0665-1083.1	CBI_Email Documenting CBI Claim and Email Deletion - DCN MF00217A1CBI	CBI_Email to document the deletion of retroactively claimed CBI items by Wayne VanTassell.	Email	Anna Dimling, ERG	06/15/2017	Dimling, A. 2017. Email Documenting CBI Claim and Email Deletion.	Metal Finishing, Part 433	3	Yes	No	MF00217A1

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10.31	EPA-HQ-OW-2015-0665-1084	Sampling Results for Pilkington Metal Finishing - DCN MF00218	Contains sample concentrations from March 2008 through January 2016. Provides results from the following parameters: Cr, Cd, Cu, CN, Ni, Mo, Zn, Pb, Ag, pH, and flow (GPD).	Data	Pilkington	07/06/2016	Pilkington. 2016. Sampling Results for Pilkington Metal Finishing.	Metal Finishing, Part 433		No	No	MF00218
10.31	EPA-HQ-OW-2015-0665-1085	Wastewater Discharge Permit for OC Tanner Manufacturing Company - DCN MF00219	Provides 2016 Wastewater Discharge Permit (SLC-0077) for OC Tanner Manufacturing Company.	Permit, Registration	Salt Lake Water	01/27/2016	Salt Lake Water. 2016. Wastewater Discharge Permit for OC Tanner Manufacturing Company.	Metal Finishing, Part 433	70	No	No	MF00219
10.31	EPA-HQ-OW-2015-0665-1085.1	Wastewater Discharge Permit Application and Baseline Monitoring Report for OC Tanner Manufacturing Company - DCN MF00219A1	Contains the application for the wastewater discharge permit renewal	Permit, Registration	Salt Lake Water	09/10/2013	Salt Lake Water. 2013. Wastewater Discharge Permit Application and Baseline Monitoring Report for OC Tanner Manufacturing Company.	Metal Finishing, Part 433	91	No	No	MF00219A1

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10.31	EPA-HQ-OW-2015-0665-1085.2	Annual Pretreatment Inspection for Production at OC Tanner Manufacturing - DCN MF00219A2	Inspection report conducted at OC Tanner Manufacturing Company (Production) by Salt Lake City Water Reclamation Pretreatment Coordinator in 2015.	Permit, Registration	Salt Lake Water	02/03/2015	Salt Lake Water. 2015. Annual Pretreatment Inspection for Production at OC Tanner Manufacturing.	Metal Finishing, Part 433	16	No	No	MF00219A2
10.31	EPA-HQ-OW-2015-0665-1085.3	Annual Pretreatment Inspection for Refinery at OC Tanner Manufacturing - DCN MF00219A3	Inspection report conducted at OC Tanner Manufacturing Company (Refinery) by Salt Lake City Water Reclamation Pretreatment Coordinator in 2015.	Permit, Registration	Salt Lake Water	02/03/2015	Salt Lake Water. 2015. Annual Pretreatment Inspection for Refinery at OC Tanner Manufacturing.	Metal Finishing, Part 433	19	No	No	MF00219A3
10.31	EPA-HQ-OW-2015-0665-1085.4	Toxic Organic Management Plan (TOMP) for OC Tanner Manufacturing Company - DCN MF00219A4	Contains the Toxic Organic Management Plan (TOMP) in lieu of sampling for TTOs under 40 CFR 433 for OC Tanner Manufacturing Company	Permit, Registration	OC Tanner	11/04/2011	OC Tanner. 2011. Toxic Organic Management Plan (TOMP) for OC Tanner Manufacturing Company.	Metal Finishing, Part 433	92	No	No	MF00219A4

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10.31	EPA-HQ-OW-2015-0665-1086	CBI_Refinery Storage Maps for OC Tanner Manufacturing Company - DCN MF00220CBI	CBI_Provides storage information about materials in the refinery	Data	OC Tanner	12/31/2013	OC Tanner. 2013. CBI_Refinery Storage Maps for OC Tanner Manufacturing Company.	Metal Finishing, Part 433	3	Yes	No	MF00220
10.31	EPA-HQ-OW-2015-0665-1086.1	Email Providing Preliminary Refinery Steps for OC Tanner Manufacturing Company - DCN MF00220A1	Email from Annette Gertge, OC Tanner, to Andra explaining the refinery processes.	Email	O.C. Tanner	01/15/2015	O.C. Tanner. 2015. Email Providing Preliminary Refinery Steps for OC Tanner Manufacturing Company.	Metal Finishing, Part 433	4	No	No	MF00220A1
10.31	EPA-HQ-OW-2015-0665-1100	Sampling Results for OC Tanner Manufacturing Company - DCN MF00221	Contains sample concentrations from August 2008 through January 2016. Provides results from the following parameters: Cr, Cd, Cu, CN, Ni, Mo, Zn, Pb, Ag, pH, and flow (GPD).	Data	OC Tanner	07/05/2016	OC Tanner. 2016. Sampling Results for OC Tanner Manufacturing Company.	Metal Finishing, Part 433		No	No	MF00221

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10.31	EPA-HQ-OW-2015-0665-1101	CBI_SDSs for OC Tanner Manufacturing Company - DCN MF00222CBI	CBI_Contains 3 SDSs for OC Tanner Manufacturing company.	Data	OC Tanner	07/05/2016	OC Tanner. 2016. CBI_SDSs for OC Tanner Manufacturing Company.	Metal Finishing, Part 433	18	Yes	No	MF00222
10.31	EPA-HQ-OW-2015-0665-1087	CBI_Email from Annette Gertge, OC Tanner Manufacturing Company Containing Information EPA Requested - DCN MF00223CBI	CBI_Delivery email from Annette Gertge containing SDSs for chemicals used at OC Tanner Manufacturing Company	Email	O.C. Tanner	08/23/2016	O.C. Tanner. 2016. CBI_Email from Annette Gertge, OC Tanner Manufacturing Company Containing Information EPA Requested.	Metal Finishing, Part 433	2	Yes	No	MF00223
10.31	EPA-HQ-OW-2015-0665-1087.1	CBI_Email Documentation of CBI Email Claim and Removal - DCN MF00223A1CBI	CBI_Documentation email chain for CBI claim and email removal for retroactive CBI claims	Email	Anna Dimling, ERG	06/16/2017	ERG. 2017. CBI_Email Documentation of CBI Email Claim and Removal.	Metal Finishing, Part 433	3	Yes	No	MF00223A1

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10.31	EPA-HQ-OW-2015-0665-1088	Wastewater Discharge Permit for Varian Medical Systems X-Ray Products - DCN MF00224	Provides 2015 Wastewater Discharge Permit (SLC-0058) for Varian Medical Systems X-Ray Products.	Permit, Registration	Salt Lake Water	11/02/2015	Salt Lake Water. 2015. Wastewater Discharge Permit for Varian Medical Systems X-Ray Products.	Metal Finishing, Part 433	54	No	No	MF00224
10.31	EPA-HQ-OW-2015-0665-1088.1	Industrial Wastewater Discharge Permit Application for Varian Medical Systems X-Ray Products - DCN MF00224A1	Industrial wastewater permit application for Varian Medical Systems X-Ray Products discharge permit (SLC-0058).	Permit, Registration	Salt Lake Water	03/30/2016	Salt Lake Water. 2016. Industrial Wastewater Discharge Permit Application for Varian Medical Systems X-Ray Products.	Metal Finishing, Part 433	74	No	No	MF00224A1
10.31	EPA-HQ-OW-2015-0665-1088.2	Analytical Lab Report for Varian Medical Systems X-Ray Products: Analytical Lab Report - DCN MF00224A2	Provides analytical lab report that was submitted by Varian Medical Systems X-Ray Products for their industrial wastewater permit application.	Data	Chemtech-Ford Lab	03/29/2016	Chemtech-Ford Lab. 2016. Analytical Lab Report for Varian Medical Systems X-Ray Products: Analytical Lab Report.	Metal Finishing, Part 433	37	No	No	MF00224A2

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10.31	EPA-HQ-OW-2015-0665-1088.3	Annual Pretreatment Inspection Report for Varian Medical Systems X-Ray Products - DCN MF00224A3	Inspection report conducted at Varian Medical Systems X-Ray Products by Salt Lake City Water Reclamation Pretreatment Coordinator in 2015.	Permit, Registration	Salt Lake Water	07/06/2015	Salt Lake Water. 2015. Annual Pretreatment Inspection Report for Varian Medical Systems X-Ray Products.	Metal Finishing, Part 433	19	No	No	MF00224A3
10.31	EPA-HQ-OW-2015-0665-1089	Wastewater Treatment Flow Diagram for Varian Medical Systems X-Ray Products - DCN MF00225	Provides a wastewater treatment diagram for Varian Medical Systems X-Ray Products designating the difference between wastewater lines and sanitary sewer lines.	Data	Varian	05/08/2013	Varian. 2013. Wastewater Treatment Flow Diagram for Varian Medical Systems X-Ray Products.	Metal Finishing, Part 433	1	No	No	MF00225
10.31	EPA-HQ-OW-2015-0665-1089.1	Building Diagram for Varian Medical Systems X-Ray Products - DCN MF00225A1	Provides the layout of the Varian Medical Systems X-Ray Products facility and specifies the part of the building with metal finishing operations.	Data	Varian	05/08/2013	Varian. 2013. Building Diagram for Varian Medical Systems X-Ray Products.	Metal Finishing, Part 433	1	No	No	MF00225A1

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10.31	EPA-HQ-OW-2015-0665-1089.2	Building Diagram with Legend for Varian Medical Systems X-Ray Products - DCN MF00225A2	Provides the layout of the Varian Medical Systems X-Ray Products facility and specifies sinks, water fountains, sub mercibel pump, manholes, and floor drains.	Data	Varian	05/02/2013	Varian. 2013. Building Diagram with Legend for Varian Medical Systems X-Ray Products.	Metal Finishing, Part 433	10	No	No	MF00225A2
10.31	EPA-HQ-OW-2015-0665-1089.3	CBI_Mass Flowchart for Varian-DCN MF00225A3CBI	CBI_Provides a full process flow diagram for the manufacturing of x-ray tubes from start to finish at Varian. Also specifies which operations generate wastewater and other wastes.	Data	Varian	07/18/2013	Varian. 2013. CBI_Mass Flowchart for Varian.	Metal Finishing, Part 433	1	Yes	No	MF00225A3
10.31	EPA-HQ-OW-2015-0665-1102	Chemical Information for Varian Medical Systems X-Ray Products - DCN MF00226	Provided chemical information (e.g., CAS number, hazards, inventory, storage locations) for chemicals used at Varian Medical Systems X-Ray Products.	Data	Varian	01/28/2016	Varian. 2016. Chemical Information for Varian Medical Systems X-Ray Products.	Metal Finishing, Part 433	178	No	No	MF00226

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10.31	EPA-HQ-OW-2015-0665-1103	Sampling Results for Varian Medical Systems X-Ray Products - DCN MF00227	Contains sample concentrations from March 2008 through April 2016. Provides results from the following parameters: Cr, Cd, Cu, CN, Ni, Mo, Zn, Pb, Ag, pH, O&G and flow (GPD).	Data	Varian	06/28/2016	Varian. 2016. Sampling Results for Varian Medical Systems X-Ray Products.	Metal Finishing, Part 433		No	No	MF00227
10.31	EPA-HQ-OW-2015-0665-1104	Industrial Wastewater Discharge Permit for Plymouth Plating Works - DCN MF00228	Final Wastewater Discharge permit for Plymouth Plating Works, Inc. effective April 2013 to March 2017.	Permit, Registration	Detroit Water	04/17/2013	Detroit Water. 2013. Industrial Wastewater Discharge Permit for Plymouth Plating Works.	Metal Finishing, Part 433	46	No	No	MF00228
10.31	EPA-HQ-OW-2015-0665-1005	Plymouth Plating Diagrams - DCN MF00229	Contains process and wastewater treatment diagrams for Plymouth Plating Works, Inc.	Data	Plymouth Plating	10/28/2010	Plymouth Plating. 2010. Plymouth Plating Diagrams.	Metal Finishing, Part 433	7	No	No	MF00229

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10.31	EPA-HQ-OW-2015-0665-1006	Industrial Wastewater Discharge Permit for KC Jones Plating Co. - DCN MF00230	Final Industrial Wastewater Discharge Permit for KC Jones Plating Co., effective March 2, 2015 to March 1, 2019.	Permit, Registration	Detroit Water	02/27/2015	Detroit Water. 2015. Industrial Wastewater Discharge Permit for KC Jones Plating Co. .	Metal Finishing, Part 433	20	No	No	MF00230
10.31	EPA-HQ-OW-2015-0665-1007	CBI_KC Jones Process Line Diagrams - DCN MF00231	CBI_Contains six process line tank layout diagrams for KC Jones Plating Co.	Data	KC Jones	10/14/2005	KC Jones. 2005. CBI_KC Jones Process Line Diagrams.	Metal Finishing, Part 433	6	Yes	No	MF00231
10.31	EPA-HQ-OW-2015-0665-1008	KC Jones Wastewater Treatment System Flow Diagram - DCN MF00232	Contains a wastewater treatment flow diagram and costs associated with the treatment system at KC Jones.	Data	KC Jones	08/15/2016	KC Jones. 2016. KC Jones Wastewater Treatment System Flow Diagram.	Metal Finishing, Part 433	7	No	No	MF00232

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10.31	EPA-HQ-OW-2015-0665-1009	Industrial Wastewater Discharge Permit for Ajax Metal Processing, Inc. - DCN MF00234	Final Industrial Wastewater Discharge Permit for Ajax Metal Processing, Inc., effective March 2, 2013 to March 1, 2017.	Permit, Registration	Detroit Water	03/01/2015	Detroit Water. 2015. Industrial Wastewater Discharge Permit for Ajax Metal Processing, Inc.	Metal Finishing, Part 433	13	No	No	MF00234
10.31	EPA-HQ-OW-2015-0665-1010	CBI_AJAX Metal Processing Process Flow Diagram - DCN MF00235	CBI_Process Flow Diagram for AJAX Metal Processing	Data	AJAX Metal Processing	08/03/2016	AJAX Metal Processing. 2016. CBI_AJAX Metal Processing Process Flow Diagram.	Metal Finishing, Part 433	1	Yes	No	MF00235
10.31	EPA-HQ-OW-2015-0665-1011	Industrial Wastewater Discharge Permit (Original) for Ford Flat Rock - DCN MF00236	Industrial Wastewater Discharge Permit for Ford Motor Company - Flat Rock Assembly Plant, effective 7/23/12 to 7/22/17. Was later modifies (see attachments).	Permit, Registration	South Huron Valley	07/20/2012	South Huron Valley. 2012. Industrial Wastewater Discharge Permit (Original) for Ford Flat Rock.	Metal Finishing, Part 433	17	No	No	MF00236

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10.31	EPA-HQ-OW-2015-0665-1011.1	Industrial Wastewater Discharge Permit (Modified 8/28/12) for Ford Flat Rock - DCN MF00236.A1	Modified Industrial Wastewater Discharge Permit for Ford Motor Company - Flat Rock Assembly Plant, effective 9/01/12 to 7/22/17. Was later modifies (see A2).	Permit, Registration	South Huron Valley	08/28/2012	South Huron Valley. 2012. Industrial Wastewater Discharge Permit (Modified 8/28/12) for Ford Flat Rock.	Metal Finishing, Part 433	4	No	No	MF00236A1
10.31	EPA-HQ-OW-2015-0665-1011.2	Industrial Wastewater Discharge Permit (Modified 9/5/12) for Ford Flat Rock - DCN MF00236.A2	Modified Industrial Wastewater Discharge Permit for Ford Motor Company - Flat Rock Assembly Plant, effective 9/06/12 to 7/22/17.	Permit, Registration	South Huron Valley	09/05/2012	South Huron Valley. 2012. Industrial Wastewater Discharge Permit (Modified 9/5/12) for Ford Flat Rock.	Metal Finishing, Part 433	2	No	No	MF00236A2
10.31	EPA-HQ-OW-2015-0665-1012	Ford Flat Rock Pre-treat/Phosphate Diagram - DCN MF00237	Flow diagram the Pre-treat/Phosphate System at Ford Flat Rock	Data	Ford Flat Rock	08/16/2016	Ford Flat Rock. 2016. Ford Flat Rock Pre-treat/Phosphate Diagram.	Metal Finishing, Part 433	1	No	No	MF00237

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10.31	EPA-HQ-OW-2015-0665-1013	Ford Flat Rock Wastewater Treatment Plant Diagram - DCN MF00238	Screenshot of wastewater treatment plant operating system. Includes schematic of treatment process.	Data	Ford Flat Rock	08/17/2016	Ford Flat Rock. 2016. Ford Flat Rock Wastewater Treatment Plant Diagram.	Metal Finishing, Part 433	1	No	No	MF00238
10.31	EPA-HQ-OW-2015-0665-1014	CBI_Wastewater Treatment Plant Invoice for Ford Flat Rock - DCN MF00239CBI	CBI_Contains operating costs for the wastewater treatment plant at Ford Flat Rock for the month of July, 2016.	Data	Ford Flat Rock	08/01/2016	Ford Flat Rock. 2016. CBI_Wastewater Treatment Plant Invoice for Ford Flat Rock.	Metal Finishing, Part 433	1	Yes	No	MF00239
10.31	EPA-HQ-OW-2015-0665-1015	Plating/Passivation Diagram for Elm Plating - DCN MF00240	Plating/Passivation process line diagram for Elm Plating	Data	Elm Plating	08/17/2016	Elm Plating. 2016. Plating/Passivation Diagram for Elm Plating.	Metal Finishing, Part 433	1	No	No	MF00240

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10.31	EPA-HQ-OW-2015-0665-1016	Wastewater Treatment Plant Process Diagram for Elm Plating - DCN MF00241	Wastewater treatment process flow diagram for Elm Plating	Data	Elm Plating	08/17/2016	Elm Plating. 2016. Wastewater Treatment Plant Process Diagram for Elm Plating.	Metal Finishing, Part 433	1	No	No	MF00241
10.31	EPA-HQ-OW-2015-0665-1017	Elm Plating Facility Schematic - DCN MF00242	Facility Schematic for Elm Plating	Data	Elm Plating	08/17/2016	Elm Plating. 2016. Elm Plating Facility Schematic.	Metal Finishing, Part 433	1	No	No	MF00242
10.31	EPA-HQ-OW-2015-0665-1018	Elm Plating SVR CBI Claims - DCN MF00243	Email from Allen Kinsler, Elm Plating containing CBI claims for the Site Visit Report for EPA and ERG's visit to the facility on August 17, 2016 and addition information provided to EPA and ERG by the facility.	Email	Elm Plating	04/24/2017	Elm Plating. 2017. Elm Plating SVR CBI Claims.	Metal Finishing, Part 433	2	No	No	MF00243

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10.31	EPA-HQ-OW-2015-0665-1019	Powder Coating Line Diagram for Methode Electronics - DCN MF00244	Powder Coating Line Flow Diagram for Methode Electronics	Data	Methode Electronics	08/18/2016	Methode Electronics. 2016. Powder Coating Line Diagram for Methode Electronics.	Metal Finishing, Part 433	1	No	No	MF00244
10.31	EPA-HQ-OW-2015-0665-1020	Wastewater Pretreatment Flow Diagram for Plating Lines/Deburring at Methode Electronics - DCN MF00245	Wastewater treatment flow diagram of the pretreatment for plating lines/deburring wastewater at Methode Electronics	Data	Methode Electronics	08/18/2016	Methode Electronics. 2016. Wastewater Pretreatment Flow Diagram for Plating Lines/Deburring at Methode Electronics.	Metal Finishing, Part 433	1	No	No	MF00245
10.31	EPA-HQ-OW-2015-0665-1021	Facility Maps for Eagle Electronics - DCN MF00246	Facility layout and process area maps for Eagle Electronics	Data	Eagle Electronics	08/18/2016	Eagle Electronics. 2016. Facility Maps for Eagle Electronics.	Metal Finishing, Part 433	2	No	No	MF00246

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10.31	EPA-HQ-OW-2015-0665-1022	Metal Impact Facility and Wastewater Treatment Diagrams - DCN MF00247	Contains a wastewater treatment flow diagram and a facility layout diagram for Metal Impact.	Data	Metal Impact, LLC	08/19/2016	Metal Impact, LLC. 2016. Metal Impact Facility and Wastewater Treatment Diagrams.	Metal Finishing, Part 433	2	No	No	MF00247
10.31	EPA-HQ-OW-2015-0665-1023	Description of MIL Operations - DCN MF00248	Contains description of operations and includes water usage rates, wastewater treatment costs, discharge monitoring data, and a wastewater treatment system diagram.	Data	MIL	08/19/2016	MIL. 2016. Description of MIL Operations.	Metal Finishing, Part 433	4	No	No	MF00248
10.31	EPA-HQ-OW-2015-0665-1049	Facility Maps for Magnetic Inspection Laboratory - DCN MF00249	Contains a facility map for MIL and tank layouts for the north half and south half of the 1401 Greenleaf Ave. facility.	Data	MIL	08/19/2016	MIL. 2016. Facility Maps for Magnetic Inspection Laboratory.	Metal Finishing, Part 433	3	No	No	MF00249

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10.31	EPA-HQ-OW-2015-0665-1050	Waste Treatment Without Wasted Space - DCN MF00250	Article published by Products Finishing (pfonlone.com). Article features the wastewater handling and waste treatment process systems at Magnetic Inspection Laboratory, Inc.	Data	Products Finishing	03/01/2010	Products Finishing. 2010. Waste Treatment Without Wasted Space.	Metal Finishing, Part 433	4	No	Yes	MF00250
10.31	EPA-HQ-OW-2015-0665-0800	Electronic Waste Recycling Act of 2003 - DCN MF00251	Provides a summary of the California enacted the Electronic Waste Recycling Act of 2003 and associated regulations to establish a funding system for the collection and recycling of certain electronic wastes.	Data	CalRecycle	04/09/2015	CalRecycle. 2017. California Environmental Protection Agency, Department of Resources Recycling and Recovery (CalRecycle). (September 5).	Metal Finishing, Part 433	1	No	No	MF00251
10.31	EPA-HQ-OW-2015-0665-0801	Understanding Reach - DCN MF00252	Contains a description of the regulation REACH in the European Union (EU).	Data	ECHA	12/29/2017	ECHA. 2017. European Union Chemicals Agency. (September 5).	Metal Finishing, Part 433	3	No	No	MF00252

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10.31	EPA-HQ-OW-2015-0665-0812	Environmental Sustainability Resource Center (ESRC) - DCN MF00253	Description of EPA's Environmental Sustainability Resource Center (ESRC), that provides pollution prevention support for EPA region 3 and 4.	Data	ESRC	01/01/2017	ESRC. 2017. Environmental Sustainability Resource Center. Available online at: http://esrconline.org/.	Metal Finishing, Part 433	1	No	No	MF00253
10.31	EPA-HQ-OW-2015-0665-0802	Great Lakes Regional Pollution Prevention Roundtable (GLRPPR): Promoting Prevention Through Information Exchange - DCN MF00254	Provides a summary of the Great Lakes Regional Pollution Prevention Roundtable (GLRPPR) Roundtable.	Data	GLRPPR	12/13/2017	GLRPPR. 2017. Promoting Pollution Prevention Through Information Exchange. Available online at: http://www.glrppr.org/.	Metal Finishing, Part 433	3	No	No	MF00254
10.31	EPA-HQ-OW-2015-0665-0803	Waste Minimalization and Recovery Technologies - DCN MF00255	Report on the surface finishing industry including waste production, waste recovery, bath regeneration, and wastewater treatment.	Data	W.J. McLeay	01/01/2001	McLay. 2001. Waste minimization and recovery technologies. Metal Finishing, 99 (1), January 2001, pp 808-841.	Metal Finishing, Part 433	28	No	No	MF00255

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10.31	EPA-HQ-OW-2015-0665-0813	Quarterly Issue Highlights: REACH, Cd, Chromates - DCN MF00256	Quarterly report from the National Association for Surface Finishing (NASF)	Data	NASF	01/01/2012	NASF. 2012. National Association for Surface Finishing. Quarterly Issue Highlights: REACH, Cd, Chromates. (January).	Metal Finishing, Part 433	6	No	Yes	MF00256
10.31	EPA-HQ-OW-2015-0665-0814	Milwaukee Area Surface Finishing Industry Metal Loadings Study 2014-2016 - DCN MF00257	Report on a study conducted by the Milwaukee Metropolitan Sewerage District (MMSD).	Data	NASF	03/01/2017	NASF. 2017. National Association for Surface Finishing Milwaukee Area Surface Finishing Industry Metal Loadings Study.	Metal Finishing, Part 433	139	No	No	MF00257
10.31	EPA-HQ-OW-2015-0665-0815	P2 & Sustainability Program Webpage - DCN MF00258	Summary of the NEWMOA pollution prevention and sustainability program	Data	NEWMOA	03/01/2013	NEWMOA. 2013. Northeast States Pollution Prevention Roundtable. P2 and Sustainability Program Webpage.	Metal Finishing, Part 433	1	No	No	MF00258

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10.31	EPA-HQ-OW-2015-0665-0816	Pollution Prevention Regional Information Center (P2RIC) Strategy - DCN MF00259	Summary of the Pollution Prevention Regional Information Center (P2RIC).	Data	P2RIC	07/09/1905	P2RIC. 2017. Pollution Prevention Regional Information Center. P2RIC Webpage Resources. Available online at: https://p2ric.org/.	Metal Finishing, Part 433	3	No	No	MF00259
10.31	EPA-HQ-OW-2015-0665-0817	Peak to Prairies: Pollution Prevention Information Center for EPA Region 8 - DCN MF00260	Provides a summary of the Peaks and Prairies trade association.	Data	Peaks and Prairies	07/09/1905	Peak to Prairies. 2017. Pollution Prevention Information Center for EPA Region 8. Available online at: http://peaktoprairies.org/.	Metal Finishing, Part 433	5	No	No	MF00260
10.31	EPA-HQ-OW-2015-0665-0818	Pacific Northwest Pollution Prevention Resource Center - DCN MF00261	Summary of the Pacific Northwest Pollution Prevention Resource Center (pprc).	Data	PPRC	07/09/1905	PPRC. 2017. Pacific Northwest Pollution Prevention Resource Center. Available online at: http://pprc.org/.	Metal Finishing, Part 433	4	No	No	MF00261

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10.31	EPA-HQ-OW-2015-0665-0819	Federal Register Notice for the Effluent Limitations Guidelines, Pretreatment Standards, and New Source Performance Standards for the Metal Products and Machinery Point Source Category; Proposed Rule - DCN MF00262	FR Notice for the MP&M Proposed Rule.	Report	U.S. EPA	01/03/2001	U.S. EPA. 2001. FR Notice for the ELGs for the MP&M Point Source Category; Proposed Rule. Washington, D.C. (January 3).	Metal Finishing, Part 433	136	No	No	MF00262
10.31	EPA-HQ-OW-2015-0665-1051	Response to Comments for the Final Effluent Guidelines and Standards for the MP&M Point Source Category - DCN MF00263	Responses to comments for the final MP&M rulemaking.	Report	U.S. EPA	06/25/1905	U.S. EPA. 2003. Response to Comments for the Final Effluent Limitations Guidelines and Standards for the MP&M PSC. Washington, D.C. (February).	Metal Finishing, Part 433	454	No	No	MF00263
10.31	EPA-HQ-OW-2015-0665-0820	Federal Register Notice for the Effluent Limitations Guidelines and New Source Performance Standards for the Metal Products and Machinery Point Source Category; Final Rule - DCN MF00264	FR Notice for the MP&M Final Rule.	Report	U.S. EPA	05/13/2003	U.S. EPA. 2003. FR Notice for the ELGs for the MP&M Point Source Category; Final Rule. Washington, D.C. (May 13).	Metal Finishing, Part 433	61	No	No	MF00264

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10.31	EPA-HQ-OW-2015-0665-0821	Fact Sheet: 2015 Definition of Solid Waste (DSW) Final Rule - DCN MF00265	Summary of the EPA's 2015 Definition of Solid Waste (DSW) final rule.	Data	U.S. EPA	07/07/1905	U.S. EPA. 2015. U.S. Environmental Protection Agency. Fact Sheet: 2015 Definition of Solid Waste (DSW) Final Rule. Washington D.C.	Metal Finishing, Part 433	4	No	No	MF00265
10.31	EPA-HQ-OW-2015-0665-0822	DMR Parameter and TRI Chemical Toxic Weighting Factors - DCN MF00266	DMR and TRI Toxic Weighting Factors (TWFs)	Data	U.S. EPA	09/01/2016	U.S. EPA. 2016. DMR Parameter and TRI Chemical Toxic Weighting Factors. Washington, D.C. (September).	Metal Finishing, Part 433	0	No	No	MF00266
10.31	EPA-HQ-OW-2015-0665-1105	Conversation with EPA Regional Pretreatment Coordinators on December 7, 2016 regarding the Metal Finishing Study - DCN MF00267	Notes from EPA's Meeting with Regional Pretreatment Coordinators on December 7, 2016 regarding the Metal Finishing Study.	Memorandum	U.S. EPA	04/10/2018	U.S. EPA. 2018. Conversation with EPA Regional Pretreatment Coordinators regarding the Metal Finishing Study.	Metal Finishing, Part 433	3	No	No	MF00267

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10.31	EPA-HQ-OW-2015-0665-1106	Conversations with NASF regarding the Metal Finishing Study - DCN MF00268	Notes from EPA's Meetings with NASF on April 20, 2016 and April 27, 2017 regarding the Metal Finishing Study. Includes a brief summary of the 2016 NASF SUR/FIN Conference in Las Vegas, Nevada.	Memorandum	U.S. EPA	03/12/2018	U.S. EPA. 2018. Conversations with NASF regarding the Metal Finishing Study.	Metal Finishing, Part 433	5	No	No	MF00268
10.31	EPA-HQ-OW-2015-0665-1052	Pollution Prevention Research and Implementation for Michigan Metal Finishers Project Kickoff Meeting Summary - DCN MF00269	Notes from the P2 Kickoff Meeting for Michigan Metal Finishers in November 2016.	Memorandum	U.S. EPA	11/29/2016	U.S. EPA. 2016. P2 Research and Implementation for Michigan MFs Project Kickoff Meeting Summary. Washington, D.C. (November).	Metal Finishing, Part 433	8	No	No	MF00269
10.31	EPA-HQ-OW-2015-0665-1107	Conversations with NACWA on March 8, 2016 regarding the Metal Finishing Study - DCN MF00270	Notes from EPA's Meeting with NACWA on March 8, 2016 regarding the Metal Finishing Study.	Memorandum	U.S. EPA	03/14/2018	U.S. EPA. 2018. Conversations with NACWA on March 8, 2016 regarding the Metal Finishing Study.	Metal Finishing, Part 433	4	No	No	MF00270

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10.31	EPA-HQ-OW-2015-0665-0823	Pollution Prevention (P2) and TRI - DCN MF00271	Provides the waste management hierarchy and summary of pollution prevention data with TRI data.	Data	U.S. EPA	08/15/2017	U.S. EPA. 2017. P2 and TRI Webpage. Accessed: August 15, 2017.	Metal Finishing, Part 433	3	No	No	MF00271
10.31	EPA-HQ-OW-2015-0665-0824	Pollution Prevention Information by Sector - DCN MF00272	Provides a summary of the Metal Finishing Pollution Prevention Resource List	Data	U.S. EPA	07/09/1905	WSPPN. 2017. Western Sustainability and Pollution Prevention Network. Pollution Prevention Information by Sector.	Metal Finishing, Part 433	5	No	No	MF00272
10.31	EPA-HQ-OW-2015-0665-0825	Zero Waste Network, Center for Environmental Excellence - DCN MF00273	Provides the homepage for the Zero Waste Network.	Data	ZWN	07/09/1905	ZWN. 2017. Zero Waste Network. Center for Environmental Excellence. Available online at: http://www.zerowastenetwork.org/.	Metal Finishing, Part 433	2	No	No	MF00273

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10.31	EPA-HQ-OW-2015-0665-0826	A Review of Metal Precipitation Chemicals for Metal-Finishing Applications - DCN MF00274	Report summarizing the chemicals used to prepitate out metals in metal finishing operations.	Data	Mark E. Andrus	11/01/2000	Andrus, M.E. 2000. A review of metal precipitation chemicals for metal-finishing applications. Metal Finishing, 98 (11), November 2000, pp 20-23.	Metal Finishing, Part 433	4	No	No	MF00274
10.31	EPA-HQ-OW-2015-0665-0827	Chromium-based regulations and greening in metal finishing industries in the USA - DCN MF00275	Paper reviewing the regulations, human health effects, and compliance options on metal finishing products containing chromium.	Data	Anil Baral, et. Al.	06/24/1905	Baral and Engelken. 2002. Chromium-based regulations and greening in MF industries in the USA. Environmental Science & Policy, 5 (2), April 2002.	Metal Finishing, Part 433	13	No	Yes	MF00275
10.31	EPA-HQ-OW-2015-0665-0828	2010 Metal Finishing Workshop hosted by New York State Pollution Prevention Institute at Rochester Institute of Technology - DCN MF00276	Presentation by the New York State Pollution Prevention Institute (NYSP2i) discussing pollution prevention for metal finishing facilities.	Data	NYSP2i	03/04/2010	NYSP2i. 2010. Metal Finishing Workshop. (March 4).	Metal Finishing, Part 433	127	No	No	MF00276

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10.31	EPA-HQ-OW-2015-0665-0829	2011 Metal Finishing Workshop hosted by New York State Pollution Prevention Institute at Rochester Institute of Technology - DCN MF00277	Presentation by the New York State Pollution Prevention Institute (NYSP2i) discussing pollution prevention for metal finishing facilities.	Data	NYSP2i	02/09/2011	NYSP2i. 2011. Metal Finishing Workshop. (Feb. 9).	Metal Finishing, Part 433	100	No	No	MF00277
10.31	EPA-HQ-OW-2015-0665-0830	Metal Finishing: How to Save on Alkaline Cleaners, Acids, and Rinse Water - DCN MF00278	Presentation by the New York State Pollution Prevention Institute (NYSP2i) discussing typical metal finishing process steps and optimized metal finishing operations (based on P2).	Data	Dave Fister	05/10/2011	NYSP2i. 2011. Metal Finishing: How to Save on Alkaline Cleaners, Acids, and Rinse Water. Presented by Dave Fister. (May 10).	Metal Finishing, Part 433	46	No	No	MF00278
10.31	EPA-HQ-OW-2015-0665-0831	Metal Finishing Webinar presented by The New York State Pollution Prevention Institute P2 Webinar (NYSP2i) and the Toxic Use Reduction Institute (TUTI) - DCN MF00279	Webinar by the New York State Pollution Prevention Institute and Toxic Use Reduction Institute on Metal Finishing.	Data	NYSP2i	01/01/2014	NYSP2i. 2014. Metal Finishing Webinar presented by NYSP2i and the Toxic Use Reduction Institute (TUTI).	Metal Finishing, Part 433	0	No	No	MF00279

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10.31	EPA-HQ-OW-2015-0665-0832	Pollution prevention in a zinc die casting company: a 10-year case study - DCN MF00280	Paper summarizing the pollution prevention methodologies applied to mass finishing processes for cleaning and polishing of miniature zinc die-casts.	Data	Park, et al.	09/12/2000	Park, et al. 2002. Pollution prevention in a zinc die casting company: a 10-year case study. Journal of Cleaner Production.	Metal Finishing, Part 433	7	No	Yes	MF00280
10.31	EPA-HQ-OW-2015-0665-0833	A Feasibility Study of Ultrafiltration/Reverse Osmosis (UF/RO)-based Wastewater Treatment and Reuse in the Metal Finishing Industry - DCN MF00281	Paper discussion applying ultrafiltration and reverse osmosis wastewater treatment technologies to metal finishing facilities.	Data	Petrinic, et al.	04/07/2015	Petrinic, et al. 2015. A feasibility study of UF/RO-based wastewater treatment and reuse in the MF industry.	Metal Finishing, Part 433	9	No	Yes	MF00281
10.31	EPA-HQ-OW-2015-0665-0834	Ferrate(VI) and ferrate(V) oxidation of cyanide, thiocyanate, and copper(I) cyanide - DCN MF00282	Paper discussing the common constituents associated with metal finishing and gold mining processes and their treatment prior to discharge.	Data	Sharma, et al.	11/16/2007	Sharma, et al. 2008. Ferrate(VI) and ferrate(V) oxidation of cyanide, thiocyanate, and copper(I) cyanide.	Metal Finishing, Part 433	7	No	Yes	MF00282

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10.31	EPA-HQ-OW-2015-0665-0835	U.S. EPA E3 Success Stories - DCN MF00283	EPA's website for E3 and Green Suppliers Network (GSN) success stories.	Data	U.S. EPA	08/15/2017	U.S. EPA. 2017. E3 Success Stories. Available online at: https://www.epa.gov/e3/e3-success-stories.	Metal Finishing, Part 433	4	No	No	MF00283
10.31	EPA-HQ-OW-2015-0665-0836	EPA Region 9, Metal Finishing Pollution Prevention Webpage - DCN MF00284	Metal finishing pollution prevention webpage for EPA Region 9.	Data	U.S. EPA	12/28/2017	U.S. EPA. 2017. EPA Region 9, MF P2 Webpage. Available online at: https://www3.epa.gov/region9/waste/p2/projects/metal.html.	Metal Finishing, Part 433	2	No	No	MF00284
10.31	EPA-HQ-OW-2015-0665-0837	Technology Integration for Sustainable Manufacturing: An Applied Study on Integrated Profitable Pollution Prevention in Surface Finishing Systems - DCN MF00285	Paper discussing technological improvement in metal finishing operations which enables for money savings and pollution prevention achievements.	Data	Xiao, et. al.	08/09/2012	Xiao & Huang. 2012. Technology Integration for Sustainable Manufacturing: An Applied Study on Integrated Profitable P2 in Surface Finishing Systems.	Metal Finishing, Part 433	11	No	Yes	MF00285

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10.31	EPA-HQ-OW-2015-0665-0838	Ferrate(VI) oxidation of zinc–cyanide complex - DCN MF00286	Paper summarizing zinc-cyanide complexes found in gold mining effluents.	Data	Ria Yngard, et. Al.	05/09/2007	Yngard, R., Damrongsiri, S., Osathaphan, K., and V.K. Sharma. 2007. Ferrate(VI) oxidation of zinc–cyanide complex. Chemosphere, 69 (5).	Metal Finishing, Part 433	7	No	Yes	MF00286
10.31	EPA-HQ-OW-2015-0665-0839	Quality Assurance Activities for the Selection of Metal Finishing Sites and Existing Data Collection during Site Visits - Revision 1 - DCN MF00287	Memorandum describes quality assurance procedures ERG will use for the selection of metal finishing sites and existing data collection during site visits under the Metal Finishing Preliminary Study.	Memorandum	Dan-Tam Nguyen, ERG	02/01/2016	ERG. 2016. Memorandum to U.S. EPA from ERG. Re: QA for the Selection of the MF Sites and Existing Data Collection During Site Visits-Revision 1.	Metal Finishing, Part 433	10	No	No	MF00287
10.31	EPA-HQ-OW-2015-0665-0840	Never Deal with Spent Acid Solution Again - DCN MF00288	Website for PRO pHx Acid Life Extender (environmental friendly and sustainable acid solution)	Data	PRO-pHx	12/01/2017	PRO-pHx, 2017. “Never Deal with Spent Acid Solution Again”. Available online at: http://www.pro-phx.com/index.htm.	Metal Finishing, Part 433	3	No	No	MF00288

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10.31	EPA-HQ-OW-2015-0665-0841	Clean Lines: Strategies for Reducing Your Environmental Footprint – Metal Finishing Operations - DCN MF00289	U.S. EPA fact sheet on strategies for reducing your environmental footprint related to metal finishing operations.	Data	U.S. EPA	11/01/2007	U.S. EPA, 2007. "Clean Lines: Strategies for Reducing Your Environmental Footprint – Metal Finishing Operations." (November).	Metal Finishing, Part 433	4	No	No	MF00289
10.31	EPA-HQ-OW-2015-0665-0842	Federal Register Notice: Effluent Limitations Guidelines, Pretreatment Standards, and New Source Performance Standards for the Metal Products and Machinery Point Source Category; Notice of Data Availability; Proposed Rule - DCN MF00290	FR Notice for the MP&M NODA for the proposed rulemaking.	Data	U.S. EPA	06/05/2002	U.S. EPA. 2002. FR Notice: ELGs for the MP&M Point Source Category; Notice of Data Availability; Proposed Rule.	Metal Finishing, Part 433	58	No	No	MF00290
10.31	EPA-HQ-OW-2015-0665-0843	Additional DMR/TRI Analyses Spreadsheet Supporting the Metal Finishing Preliminary Study - April 2018 - DCN MF00291	Spreadsheet summarizing additional analyses conducted on the DMR/TRI data in April 2018.	Data	ERG	04/12/2018	ERG. 2018. Additional DMR/TRI Analyses Spreadsheet Supporting the Metal Finishing Preliminary Study - April 2018.	Metal Finishing, Part 433	0	No	No	MF00291

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10.31	EPA-HQ-OW-2015-0665-1024	Preliminary Review of the Metal Finishing Category - DCN MF00292	The report summarizes the analyses completed in 2016 and 2017 supporting the preliminary study of the Metal Finishing Category.	Publication USEPA	U.S. EPA	04/24/2018	U.S. EPA. 2018. Preliminary Review of the Metal Finishing Category. (April).	Metal Finishing, Part 433	68	No	No	MF00292
10.31	EPA-HQ-OW-2015-0665-1108	Economic Profile of the Metal Finishing Industry - DCN MF00293	The report summarizes the economic profile of the metal finishing industry supporting the preliminary study of the Metal Finishing Category.	Publication USEPA	U.S. EPA	04/26/2018	U.S. EPA. 2018. Economic Profile of the Metal Finishing Industry. (April).	Metal Finishing, Part 433	53	No	No	MF00293

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United States
Environmental Protection
Agency

User Guide to the Docket for the Final 2016 Effluent Guidelines Program Plan

EPA Docket Number EPA-HQ-OW-2015-0665 (www.regulations.gov)

April 2018
DCN 08544

1.0 OVERVIEW

Under the Clean Water Act (CWA), EPA establishes technology-based national regulations, termed "effluent limitations guidelines and standards," to reduce pollutant discharges from categories of industrial facilities to waters of the United States. Under the CWA, EPA similarly establishes technology-based regulations, termed "pretreatment standards" to reduce indirect pollutant discharges from industrial facilities to waters of the United States.

The CWA also specifies effluent guideline planning and review requirements. There are different requirements for direct and indirect dischargers, but both specify annual review of promulgated effluent guidelines and pretreatment standards. For direct dischargers, the CWA requires EPA to publish an Effluent Guidelines Program Plan every two years after allowing for public review and comment on the plan prior to final publication.

This document provides information on the docket supporting the Final 2016 Effluent Guidelines Program Plan (Final 2016 Plan). See the Federal Register Notice presenting EPA's Final 2016 Plan, 83 Federal Register 19281 (02 May 2018). Documents cited in the Final 2016 Plan are listed in Attachment 3, with their Regulations.gov Document ID Numbers noted. Key supporting documents are also available on EPA's Effluent Guidelines Program Planning webpage.

2.0 BACKGROUND INFORMATION ON THE DOCKET

What is the Docket and How Can I Gain Access to It?

Docket ID No. EPA-HQ-OW-2015-0665 is the official docket for EPA's Final 2016 Plan for existing effluent limitations guidelines. The official docket consists of the documents specifically referenced in the Federal Register notices of these actions, any public comments received, and other related information. Although it is a part of the official docket, Confidential Business Information (CBI) or other information whose disclosure is restricted by statute is not included in the materials available to the public.

The official public docket is the collection of electronic and hard copy materials that is available for public viewing at the Water Docket in the EPA Docket Center, (EPA/DC), located in the EPA Headquarters Library, WJC West Building, Room Number 3334, 1301 Constitution Ave., NW, Washington, DC. An electronic version of the public docket is available through a federal-wide electronic docket management system located at www.regulations.gov.

You may use the Regulations.gov web site to view public comments, access a listing of the contents of the official docket, and access those documents in the public docket that are available electronically. Certain documents are not available in the electronic docket system. These documents include, but are not limited to copyright-protected material; physical objects such as maps, aerial photographs, colored charts; and information that has been claimed as confidential. Although not all docket materials may be available electronically, you may still access any of the publicly-available docket materials at the EPA Docket Center.

Can I retrieve information that has been claimed "Confidential Business Information?"

The docket may contain some documents that contain confidential business information (CBI). CBI documents are not available for review by the public, and are not filed in the Water Docket in the EPA Docket Center. Some documents are classified as CBI because companies providing the information specifically claimed certain information (e.g., operating or financial data) as CBI. Other documents are classified as CBI because release of these documents could indirectly reveal information claimed to be confidential.

How is the Docket for EPA's Final 2016 Plan related to the Docket for the Preliminary 2016 Effluent Guidelines Program Plan?

The CWA requires EPA to publish an Effluent Guidelines Program Plan every two years after allowing for public review and comment on the plan prior to final publication. Documents supporting the Preliminary 2016 Effluent Guidelines Program Plan, including the 2015 annual review of existing effluent limitations guidelines are also located in Docket ID No. EPA-HQ-OW-2015-0665. All of the documents in the docket supporting the 2015 Annual Review and Preliminary 2016 Effluent Guidelines Program Plan also support the 2016 Annual Review and Final 2016 Plan. EPA has also incorporated by reference all of the documents in the dockets supporting the Plans for 2004, 2006, 2008, 2010, 2012, and 2014 which include the annual reviews for years 2003-2014. See EPA-HQ-OW-2006-0771-0822 (DCN 05106), EPA-HQ-OW-2008-0517-0475 (DCN 06937), EPA-HQ-OW-2010-0824-0121 (DCN 07722), EPA-HQ-OW-2014-0170-0078 (DCN 07987), and EPA-HQ-OW-2015-0665-0302 (DCN 08311).

3.0 ACCESSING INFORMATION IN THE DOCKET

How Do I Find Documents in the Docket?

Water Docket in the EPA Docket Center

The official public docket is the collection of electronic and hard copy materials that is available for public viewing at the Water Docket in the EPA Docket Center, (EPA/DC), located in the EPA Headquarters Library, WJC West Building, Room Number 3334, 1301 Constitution Ave., NW, Washington, DC. The Public Reading Room is open from 8:30 a.m. to 4:30 p.m., Monday through Friday, excluding legal holidays. The telephone number for the Public Reading Room is (202) 566–1744, and the telephone number for the Water Docket is (202) 566–2426. You can also contact the Water Docket via e-mail: OW-Docket@epa.gov.

Regulations.gov

You will find instructions for using Regulations.gov on its Internet home page. Regulations.gov provides limited electronic search capabilities. If you know the Document ID Number (e.g., EPA-HQ-OW-2015-0665-1025) of the document you wish to view, you can type that number directly into the field beneath the "SEARCH" heading.

If you do not know the specific Document ID Number, you can input the docket identification number (EPA-HQ-OW-2015-0665) in the field beneath the "SERACH" heading and click Search. You will now see a listing of the contents of the official docket in the public record. The listing includes the Document Title (e.g., "Final 2016 Effluent Guidelines Program Plan"), Document ID Number (e.g., EPA-HQ-OW-2015-0665-1025), Date Posted (e.g., "May 2, 2018"), Document Type (e.g., "Notice"), and other information.

You have several options to narrow your search within the docket listing by using the filters under the "Select Document Type" field. For example, you can specify the Document Type (e.g., Public Submissions, Notices, or Rules) as well as status (e.g. Open for Comment/Submission).

How are Documents Organized in the EPA-HQ-OW-2015-0665 Docket?

Each document in the docket has two document identification numbers. One is the Regulations.gov Document ID Number (e.g., EPA-HQ-OW-2015-0665-1025) that was assigned when EPA added the document to the official docket. The last four digits are the unique consecutive regulations.gov document ID. The second is the document control number (DCN) that was assigned during the development of the document (e.g., DCN 08317). In documents prepared for the docket, EPA typically identifies references by their DCN. The DCN appears at the end of the document titles in the **Document Title** field listed in Regulations.gov (e.g., "Final 2016 Effluent Guidelines Program Plan - DCN 08317").

What is the Docket EPA-HQ-OW-2015-0665 Subject Outline?

EPA has prepared a *subject outline* of the documents included in EPA-HQ-OW-2015-0665 to help you locate documents that address related topics or subjects. The subject outline for EPA-HQ-OW-2015-0665 is provided in Attachment 1. With the exception of public submissions, each document in the docket has been assigned to an outline section.

What is the Docket EPA-HQ-OW-2015-0665 Subject Index?

The docket EPA-HQ-OW-2015-0665 *subject index* is a list of documents in the docket, sorted by subject outline section, available as Attachment 2 to this document. Because of its size, Attachment 2 is available separately, at DCN 08544A1. The subject index summarizes certain information for each document, including the subject outline section, Regulations.gov Document ID Number, DCN, document title, author, and abstract. EPA assigned each document to a subject outline section during the development of the document.

The subject index for the docket includes the following fields:

Field Name	Description
Record Section	Section number from docket subject outline.
Regulations.gov Document ID Number	Unique document number assigned when EPA added the document to the official docket. The Document ID Number includes the Docket Number (e.g., EPA-HQ-OW-2015-0665) followed by a consecutive document number to distinguish the individual documents within the docket.
Title	Title of document.
Abstract	Additional description of document.
Document Type	Type of supporting and related materials (e.g., publication, meeting materials, data, etc.).
Author	Author of document (Last name, first full name).
Author Date	Date of publication, issue, edition, or version. Actual date of meeting or telephone call.
Source Citation	For copyright protected documents, this is a bibliographic citation (without title or author) that you can use to find the document in a library. For materials retrieved from the Internet, Source Citation lists the URL.
Category Industry	Industry category that the document is supporting.
Page	Number of pages in document.
CBI	Confidential Business Information (Yes/No). CBI is not available to the public.
Copyrighted	(Materials that are copyright protected (e.g., books and other published material) (Yes/No). Copyrighted documents are not available through Regulations.gov; they are only available in hard copy at the EPA Docket Center.
DCN	Unique document control number (DCN) assigned during the development of the document.

How Do I Use the Subject Index to Find Documents in the Docket?

Review the subject outline (see Attachment 1) to determine which section may contain the documents of interest. Then, locate documents for that section in the index and note their Regulations.gov Document ID Number. Documents available electronically can be accessed through Regulations.gov. Other documents can be reviewed at the Water Docket in the EPA Docket Center in Washington, DC. See information on the Water Docket above. You may also be able to locate copyright protected materials (for example, articles from technical publications) at an academic or public library.

4.0 Further Information

The primary contact regarding questions or comments on Docket ID No. EPA-HQ-OW-2015-0665 and the Final 2016 Effluent Guidelines Program Plan is:

Dr. Phillip Flanders
U.S. EPA
Office of Water
Engineering and Analysis Division (4303T)
1200 Pennsylvania Avenue, NW
Washington, DC 20460

(202) 566-8323 (telephone)
(202) 566-1053 (fax)
flanders.phillip@epa.gov

Attachment 1

SUBJECT OUTLINE FOR THE PRELIMINARY 2016 EFFLUENT GUIDELINES PROGRAM PLAN DOCKET EPA-HQ-OW-2015-0665

Final 2016 Effluent Guidelines Program Plan Docket Subject Outline

Docket EPA-HQ-OW-2015-0665

The following existing sections include the docket materials for the 2004 Effluent Guidelines Program Plan.

1 Docket OW-2003-0074: Background Documents *(includes TSD and appendices)*

2 Docket OW-2003-0074: Screening Level Review (supporting 2004 Plan)

3 Docket OW-2003-0074: Industry Rankings

The following sections will be used to organize the docket and project file materials for the 2006, 2008, 2010, 2012, 2014, and 2016 Effluent Guidelines Program Plans.

4 Public Comments

Docket EPA-HQ-OW-2004-0032
Docket EPA-HQ-OW-2003-0074
Docket EPA-HQ-OW-2006-0771
Docket EPA-HQ-OW-2008-0517
Docket EPA-HQ-OW-2010-0824
Docket EPA-HQ-OW-2014-0170
Docket EPA-HQ-OW-2015-0665

5 No entries

6 Federal Register Notices, Outreach Materials, and Other Background Documents

6.1 Previous Dockets, by reference
6.2 Federal Register Notices
6.3 Outreach Efforts
6.4 Technical Support Documents and Appendices

7 Public and Inter-Agency Comments

7.1 Public Comments on the 2004 Effluent Guidelines Program Plan
7.2 Public Comments on the Preliminary 2006 Effluent Guidelines Program Plan
7.3 Public Comments on the Final 2006 Effluent Guidelines Program Plan
7.4 Public Comments on the Preliminary 2008 Effluent Guidelines Program Plan
7.5 Public Comments on the First CBM ICR (January 2008)
7.6 Public Comments on the first HCI ICR (August 2008)
7.7 Public Comments on the Final 2008 Effluent Guidelines Program Plan
7.8 Public Comments on the Preliminary 2010 Effluent Guidelines Program Plan
7.9 Public Comments on the Final 2010 Effluent Guidelines Program Plan
7.10 Public Comments on the Preliminary 2012 Effluent Guidelines Program Plan

7.11 Public Comments on the Final 2012 Effluent Guidelines Program Plan
7.12 Public Comments on the Preliminary 2014 Effluent Guidelines Program Plan
7.13 Public Comments on the Preliminary 2016 Effluent Guidelines Program Plan

8 CWA §304(g) Review

Review of the pretreatment standards for industrial point source categories composed entirely or almost entirely of indirect dischargers.

8.1 Food Service Establishments
8.2 Industrial Laundries
8.3 Photo-processing
8.4 Printing and Publishing
8.5 Health Services Industries
    8.5.1 Independent and Stand-alone Medical and Dental Laboratories
    8.5.2 Offices and Clinics of Doctors of Medicine
    8.5.3 Offices and Clinics of Dentists
    8.5.4 Nursing and Personal Care Facilities
    8.5.5 Veterinary Care Services
    8.5.6 Hospitals and Clinics
    8.5.7 Health Services Industries Economic Information
8.6 Independent and Stand-alone Laboratories
8.7 Industrial Container and Drum Cleaning (ICDC)
8.8 Tobacco Products Processing
8.9 Correctional Institutions (Prisons)

9 Screening-Level Reviews

Screening-level review of existing guidelines and standards and new categories.

9.1 Analyses of the Toxics Release Inventory
    Plan, database, QC checks (including telecons)
9.2 Analyses of Permit Compliance System data Plan, ICIS-NPDES Data Plan, database, QC checks (including telecons)
9.3 Other Screening-Level Data Sources NAICS/SIC/Point Source Category Crosswalks
9.4 Screening-Level Review Reports
    QA Project Plans for TRI and PCS Analysis,
    2005 Screening-Level Analysis Report
    Nutrients Memo
9.5 Toxic Weighting Factor Development

10 Existing Guidelines and Standards Review

Further review based on National Strategy Factors, of industries with existing guidelines and standards, prioritized during screening-level review. The National Strategy Factors are: 1) human health and environment hazards; 2) technology innovation and process changes; 3) economics; 4) implementation and efficiency considerations.

10.1 Review Reports Review of Prioritized Categories of Industrial Dischargers

All existing categories are listed below. Potential new subcategories are included with their parent category. If no materials specific to a category are collected, the section will be identified as "no entries." Materials collected in support of detailed studies are organized in additional sections, following Section 11.

10.2 Aluminum Forming, Part 467
10.3 Aquatic Animal Production Industry, Part 451
10.4 Asbestos Manufacturing, Part 427
10.5 Battery Manufacturing, Part 461
10.6 Centralized Waste Treaters, Part 437
10.7 Canned and Preserved Seafood, Part 408
10.8 Carbon Black Manufacturing, Part 458
10.9 Cement Manufacturing, Part 411
10.10 Coal Mining, Part 434
10.11 Coil Coating, Part 465
10.12 Concentrated Animal Feeding Operations, Part 412
10.13 Copper Forming, Part 468
10.14 Dairy Products Processing, Part 405
10.15 Electrical and Electronic Components, Part 469
10.16 Electroplating, Part 413
10.17 Explosives, Part 457
10.18 Ferroalloy Manufacturing, Part 424
10.19 Fertilizer Manufacturing, Part 418
10.20 Fruits and Vegetable Processing, Part 407
10.21 Glass Manufacturing, Part 426
10.22 Grain Mills Manufacturing, Part 406
10.23 Gum and Wood Chemicals, Part 454
10.24 Hospitals, Part 460
10.25 Ink Formulating, Part 447
10.26 Inorganic Chemicals, Part 415
10.27 Iron and Steel Manufacturing, Part 420
10.28 Landfills, Part 445
10.29 Leather Tanning and Finishing, Part 425
10.30 Meat and Poultry Products, Part 432
10.31 Metal Finishing, Part 433
10.32 Metal Molding and Casting (Foundries), Part 464
10.33 Metal Products and Machinery, Part 438
10.34 Mineral Mining and Processing, Part 436
10.35 Nonferrous Metals Forming and Metal Powders, Part 471

10.36 Nonferrous Metals Manufacturing, Part 421
10.37 Oil & Gas Extraction, Part 435
 10.37.1 Coalbed Methane
 10.37.2 Shale Gas Extraction
10.38 Ore Mining and Dressing, Part 440
10.39 Organic Chemicals, Plastics and Synthetic Fibers, Part 414 (including Thompson Report response materials)
 10.39.1 Chemical Formulating, Packaging and Repackaging
 10.39.2 Biodiesel, Ethanol, and Other Biofuels
10.40 Paint Formulating, Part 446
10.41 Paving and Roofing Materials (Tars and Asphalt), Part 443
10.42 Pesticide Chemicals Manufacturing, Formulation and Repackaging, Part 455
10.43 Petroleum Refining, Part 419
 10.43.1 Petroleum Bulk Stations and Terminals (PBST)
10.44 Pharmaceutical Manufacturing, Part 439
10.45 Phosphate Manufacturing, Part 422
10.46 Photographic, Part 459
10.47 Plastic Molding and Forming, Part 463
10.48 Porcelain Enameling, Part 466
10.49 Pulp, Paper, and Paperboard, Part 430 (materials not related to detailed study, e.g., Phase III permit writers support materials)
10.50 Rubber Manufacturing, Part 428
10.51 Soaps and Detergents Manufacturing, Part 417
10.52 Steam Electric Power Generation, Part 423
10.53 Sugar Processing, Part 409
10.54 Textile Mills, Part 410
10.55 Timber Products Processing, Part 429
10.56 Transportation Equipment Cleaning, Part 442
10.57 Waste Combustors (Commercial Incinerators Combusting Hazardous Waste), Part 444

11 Review of Categories Without Existing Guidelines

11.1 Airport Deicing Operations (now Part 449)
11.2 Water Supply (Drinking Water Treatment)
11.3 Miscellaneous Foods and Beverages
 11.4.1 Distilled and Blended Liquor
 11.4.2 Malt Beverages
 11.4.3 Soybean Oil Mills
 11.4.4 Miscellaneous Foods and Beverages Economic Information
11.4 Liquefied Natural Gas Import Terminals
11.5 Biofuel Manufacturing
11.6 Engineered Nanomaterials Manufacturing and Production Use
11.7 Brick and Structural Clay Products Manufacturing

12 Water Pollution Control Technologies, Water Reuse, Water Conservation
Include information about pollution prevention, wastewater treatment, and other wastewater pollution control technologies that applies to multiple point source categories. Technologies or case studies that focus on one category should be included in the section for the category or detailed study.

12.1 Water Conservation Issues
12.2 Wastewater Treatment Technologies Investigation

13 Steam Electric Power Generation Detailed Study (closed as of December 2009)

13.1 Study Plans
Detailed Study Plan, QA Project Plan
13.2 Industry Profile
13.3 NPDES Permits
13.4 Stakeholder Meeting Material
13.5 Pollution Control Technologies and Their Costs
13.6 Industry Surveys
13.7 Detailed Study Reports
13.8 Site Visits
13.9 Sampling
13.10 EPA Data Request Development Files
13.11 Technology Options, Costs, and Loads
13.12 Environmental Assessment Documentation

14 Tobacco Products Processing Detailed Study (closed as of December 2006)

14.1 Study Plans (Detailed Study Plan, QA Project Plan)
14.2 Industry Profile (include information on companies and individual plants)
14.3 Site Visits, Sampling and Analysis (include pre-sampling telephone contact reports)
14.4 Pollution Control Technologies and Their Costs
14.5 Detailed Study Reports
14.6 Tobacco Products Economic Information

15 Pulp, Paper, and Paperboard Detailed Study (closed as of December 2006)

15.1 Study Plans (Detailed Study Plan)
15.2 Industry Information
Meeting summary, AF&PA disputed loads letter with enclosures, AF&PA minimum monitoring letter with enclosures, Mill discharge data (i.e., minor discharger, Washington mills), Phase I Mill Industry Profile.
Draft TRI Guidance Document, TAPPI paper Comparing Chlorinated Phenolic loadings
15.2.1 Pulp and Paper Industry Economic Information
15.3 Quality Review
Designation of SIC codes into Phase, Changes to Phases, telecons (i.e., Kimberly- Clark Everett WA, Weyerhaeuser surface impoundment, IP-Cantonment Permit Status)
15.4 NPDES Permits (Includes factsheets and communication from mills that defined outfalls)
15.4.1 Phase I mill permits

15.4.2 Phase II mill permits

15.5 Detailed Study Reports

16 Coal Mining Detailed Study (closed as of 2006)

16.1 Study Plans (Detailed Study Plan, QAPP)
16.2 Industry profile for the coal mining industry
16.3 Pollutant loads
Data Obtained from states and IMCC
Pollutant Loads Concept Memo
Loads spreadsheets and results
16.4 Treatment technologies and costs
Model mine memo, AMD Treat review, costing spreadsheets and results
16.5 Environmental assessment
Memos addressing "Key questions"
Articles collected related to impacts of manganese
16.6 Flight 93 Memorial Site Information
Joanne Hanley e-mails, Lenny Lichvar document, PBS Coals letters
16.7 Non-CWA Regulations (SMCRA, Other Federal, and State Laws)
16.8 Economics, Bonds, and Trust Funds

17 Health Care Detailed Study (closed as of 2011)

17.1 Study Plans and Reports
17.2 Dental Hg Industry Profile and Background Information (including wastewater characteristics, regulations, guidance)
17.3 Dental Hg BMPs, Control Technologies, and their Costs
17.4 Dental Hg POTW Treatment Efficiencies, pass through, and interferences
17.5 Dental Hg Economic Information
17.6 Dental Hg Meetings
17.7 Unused Pharmaceuticals Industry Profile and Background Information (including wastewater characteristics, regulations, guidance)
17.8 Unused Pharmaceuticals Data Request and Responses
17.9 Unused Pharmaceuticals BMPs, Control Technologies, and their Costs
17.10 Unused Pharmaceuticals POTW Treatment Efficiencies, pass through, and interferences
17.11 Unused Pharmaceuticals Economic Information
17.12 Unused Pharmaceuticals Meetings and Site Visits

18 Coalbed Methane Detailed Study (closed as of 2014)

18.1 Plans
18.2 Stakeholder Meetings
18.3 Site Visits/Sampling
18.4 Industry Survey Development and Distribution
18.4.1 Questionnaire Development
18.4.2 Survey Sampling Strategy includes development of mailing list
18.4.3 Information Collection Request includes burden estimate, drafts of ICRs
18.5 Industry Survey Results

18.5.1 Responses raw completed questionnaires
18.5.2 Database(s)
18.6 Technical Background Information
18.6.1 Produced water quality and volume data
18.6.2 Reuse and Treatment Technologies technology performance and costs
18.7 Economic Background Information
18.8 Environmental Assessment Background Information
18.9 Detailed Study Reports

19 EPA's Even Year Analyses

19.1 Review of Industrial Pollutants in Sewage Sludge
19.2 Review of EPA Chemical Action Plans
19.3 Review of Air Regulations
19.4 Review of TRI Industry Sectors Expansion
19.5 Review of Analytical Methods

Attachment 2

SUBJECT INDEX LISTING ALL DOCUMENTS SUPPORTING THE FINAL 2016 EFFLUENT GUIDELINES PROGRAM PLAN

Attachment 3

DOCUMENTS CITED IN THE FINAL 2016 EFFLUENT GUIDELINES PROGRAM PLAN

DCN	Title	Docket/Document ID
08412	Frequently Asked Questions and the National Pollutant Release Inventory (NPRI) - DCN 08412	EPA-HQ-OW-2015-0665-0404
08414	2014-2015 NPRI Substance List – DCN 08414	EPA-HQ-OW-2015-0665-0411
08415	Raw NPRI Data: Inventaire national des rejets de polluants 2013 / National Pollutant Release Inventory 2013 – DCN 08415	EPA-HQ-OW-2015-0665-0406
08416	Guide for Reporting to the National Pollutant Release Inventory 2014 and 2015 – DCN 08416	EPA-HQ-OW-2015-0665-0407
07754	Environmental Engineering Support for Clean Water Regulations Programmatic Quality Assurance Project Plan (PQAPP) – DCN 07754	EPA-HQ-OW-2010-0824-0229
00554	A Strategy for National Clean Water Industrial Regulations: Effluent Limitations Guidelines, Pretreatment Standards, and New Source Performance Standards – DCN 00554	EPA-HQ-OW-2003-0074-0215
06557	Technical Support Document for the Annual Review of Existing Effluent Guidelines and Identification of Potential New Point Source Categories – DCN 06557	EPA-HQ-OW-2008-0517-0515
07755	U.S. EPA National Pollution Discharge Elimination System (NPDES) Permit Writers' Manual – DCN 07755	EPA-HQ-OW-2010-0824-0236
07756	Final 2012 and Preliminary 2014 Effluent Guidelines Program Plans – DCN 07756	EPA-HQ-OW-2014-0170-0002
08107	Final 2014 Effluent Guidelines Program Plan – DCN 08107	EPA-HQ-OW-2014-0170-0210
08520	Final NPDES Electronic Reporting Rule – DCN 08520	EPA-HQ-OW-2015-0665-0510
08418	2014 TRI Chemical List, Toxics Release Inventory Program – DCN 08418	EPA-HQ-OW-2015-0665-0409
08291	Changes To The TRI List Of Toxic Chemicals, Toxics Release Inventory Program – DCN 08291	EPA-HQ-OW-2015-0665-0251
08208	Preliminary 2016 Effluent Guidelines Program Plan – DCN 08208	EPA-HQ-OW-2015-0665-0290
08209	The 2015 Annual Effluent Guidelines Review Report – DCN 08209	EPA-HQ-OW-2015-0665-0299
08318	Effluent Guidelines Planning Review Report Supporting the Final 2016 Effluent Guidelines Program Plan – DCN 08318	EPA-HQ-OW-2015-0665-1056

Message

From: Flanders, Phillip [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=0CB247EF96F642F98CB727A9ED48E49E-FLANDERS, P]
Sent: 5/7/2018 9:49:17 PM
To: Laura Seidman [laura.seidman@icloud.com]
Subject: RE: Review report supporting the final 2016 plan
Attachments: ELG Review Report Supporting Final 2016 Plan_FINAL_508.pdf

Sorry that it can be a pain to search dockets on regulations.gov. Here's the Review Report that you requested.

Phillip Flanders, Ph.D., P.E.

Environmental Engineer
Engineering and Analysis Division
Office of Science and Technology
Office of Water

Mail Code 4303T
(202) 566-8323
www.epa.gov/eg

-----Original Message-----
From: Laura Seidman [mailto:laura.seidman@icloud.com]
Sent: Monday, May 07, 2018 5:04 PM
To: Flanders, Phillip <Flanders.Phillip@epa.gov>
Subject: Review report supporting the final 2016 plan

Hi Phillip,

Thanks for your help. Please send the link for the review report supporting the final 2016 plan.

Thanks for your help,
Laura

United States
Environmental Protection
Agency

Effluent Guidelines Planning Review Report Supporting the Final 2016 Effluent Guidelines Program Plan

April 2018

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U.S. Environmental Protection Agency
Office of Water (4303T)
1200 Pennsylvania Avenue, NW
Washington, DC 20460

EPA-821-R-18-002

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LIST OF FIGURES

1. INTRODUCTION TO EPA'S REVIEW SUPPORTING THE FINAL 2016 EFFLUENT GUIDELINES PROGRAM PLAN

Effluent limitations guidelines and standards (ELGs) are an essential element of the nation's clean water program, established by the 1972 amendments to the Federal Water Pollution Control Act (which then became known as the Clean Water Act (CWA)). ELGs are technology-based regulations used to control industrial wastewater discharges. This regulatory program substantially reduces industrial wastewater pollution and continues to be a critical aspect of the effort to clean the nation's waters.

EPA issues ELGs for new and existing sources that discharge directly to surface waters, as well as those that discharge to publicly owned treatment works (POTWs) (indirect dischargers). ELGs are typically applied in discharge permits as limits on the quantity of pollutants that facilities may discharge. To date, EPA has established ELGs to regulate wastewater discharges from 59 industrial point source categories. In addition to developing new ELGs, the CWA requires EPA to revise existing ELGs when appropriate. Over the years, EPA has revised ELGs in response to developments such as advances in treatment technology and changes in industry processes.

To fulfill CWA requirements, EPA conducts an annual review and effluent guidelines planning process. The review and planning process has three main objectives: (1) to review existing ELGs and to identify guidelines that are candidates for revision, (2) to identify new categories of direct dischargers for possible development of ELGs, and (3) to identify new categories of indirect dischargers for possible development of pretreatment standards.

This report documents EPA's methodology and evaluations from its review supporting the *Final 2016 Effluent Guidelines Program Plan* (Final 2016 Plan) (U.S. EPA, 2018). The Final 2016 Plan provides background on the CWA and ELG planning process, summarizes the results of this review, and details EPA's proposed actions and follow-up. The Final 2016 Plan also identifies any industrial categories newly selected for an effluent guideline rulemaking and provides a schedule for such rulemaking.

For this review, EPA:

- Considered public comments on the *Preliminary 2016 Effluent Guidelines Program Plan* (Preliminary 2016 Plan) (U.S. EPA, 2016).
- Continued its preliminary review of the discharge and treatment of pollutants from several point source categories identified for further review in the Preliminary 2016 Plan (U.S. EPA, 2016). These point source categories are Iron and Steel Manufacturing (40 CFR Part 420); Organic Chemicals, Plastics, and Synthetic Fibers (OCPSF) (40 CFR Part 414); and Pulp, Paper, and Paperboard (Pulp and Paper) (40 CFR Part 430). Specifically, EPA evaluated effluent concentrations, process operations contributing to discharges, and available treatment technologies for a subset of pollutants identified for further review.
- Continued its review of several point source categories brought to EPA's attention through public and stakeholder comments and input. These point source categories are Battery Manufacturing (40 CFR Part 461) and Electrical and Electronic

Components (E&EC) (40 CFR Part 469) (U.S. EPA, 2016). Specifically, EPA further evaluated recent changes within the industries, as well as potential new pollutant releases to the environment through industrial wastewater discharges that may not be adequately regulated by current ELGs.

- Initiated a preliminary review of miscellaneous food and beverage manufacturing sectors not currently regulated by national ELGs, to identify specific sectors that may require further review for the potential development of ELGs. Specifically, EPA analyzed current wastewater discharges, and for a subset of industry sectors, further evaluated sector processes and treatment characteristics.
- Continued investigating several pollutants/pollutant groups and general advances in industrial wastewater treatment, as identified in the *Final 2014 Effluent Guidelines Program Plan* (U.S. EPA, 2015). Specifically, EPA continued its (1) investigation of the manufacture and processing of engineered nanomaterials (ENMs) as a potential new source of industrial wastewater discharge; (2) review of industrial wastewater treatment technology data for inclusion in the Industrial Wastewater Treatment Technology (IWTT) Database; and (3) targeted review of pesticide active ingredient (PAI) discharges not currently regulated under the Pesticide Chemicals ELGs (40 CFR Part 455).

Section 2 of this report describes EPA's general methodology for evaluating available industrial wastewater discharge data, including effluent concentrations. Sections 4 through 6 present EPA's specific methodology and evaluations for each of the analyses described above.

1.1 Introduction References

1. U.S. EPA. (2015). *Final 2014 Effluent Guidelines Program Plan*. Washington, D.C. (July). EPA-821-R-15-001. EPA-HQ-OW-2014-0170-0210.

2. U.S. EPA. (2016). *Preliminary 2016 Effluent Guidelines Program Plan*. Washington, D.C. (June). EPA-821-R-16-001. EPA-HQ-OW-2015-0665-0290.

3. U.S. EPA. (2018). *Final 2016 Effluent Guidelines Program Plan*. Washington, D.C. (April). EPA-821-R-18-001. EPA-HQ-OW-2015-0665. DCN 08317.

2. INDUSTRIAL WASTEWATER DISCHARGE DATA: SOURCES, METHODOLOGY, AND QUALITY REVIEW

This section describes the data sources, general methodology, and EPA's quality review of available industrial wastewater discharge data, including discharge monitoring report (DMR), Toxics Release Inventory (TRI) and Canada's National Pollutant Release Inventory (NPRI) data.

EPA typically uses DMR and TRI data for its annual reviews as a screening tool to evaluate industrial wastewater discharges. For this review, EPA evaluated available DMR and TRI data as part of its continued evaluation of the Iron and Steel Manufacturing, Organic Chemicals, Plastics, and Synthetic Fibers (OCPSF), Pulp, Paper, and Paperboard (Pulp and Paper), Battery Manufacturing, Electrical and Electronic Components (E&EC), and Pesticides Chemicals point source categories, as well as miscellaneous food and beverage sectors. Section 2.1 describes the DMR and TRI data sources and EPA's quality review of the data. Sections 4, 5, and 6 describe EPA's specific analyses of the data related to these category and sector reviews.

For the Iron and Steel Manufacturing, OCPSF, and Pulp and Paper point source category reviews, EPA also evaluated data in Canada's NPRI. EPA assessed NPRI's usefulness as an additional data source that could indicate potential additional pollutants present in industrial wastewater discharges. Section 2.2 describes NPRI and EPA's quality review of the data. Section 4 presents EPA's analysis of the NPRI data as part of its continued review of these categories.

2.1 DMR and TRI Data

As a first step, EPA downloaded the 2014 TRI and DMR data from EPA's Water Pollutant Loading Tool (formerly the DMR Pollutant Loading Tool). EPA primarily used 2014 data because they represented the most recent and complete set of industrial wastewater discharge data available at the time of this review.

The Water Pollutant Loading Tool captures DMR data from the Integrated Compliance Information System for the National Pollutant Discharge Elimination System (ICIS-NPDES). These data include, but are not limited to facility-, outfall-, and monitoring-period specific concentrations, quantities, and flows and, where available, pollutant-specific permit limits for specific facilities. The Water Pollutant Loading Tool estimates the annual load of pollutants discharged (pounds per year) from specific facilities directly to surface water using DMR concentration and flow data.

The Water Pollutant Loading Tool also captures facility-specific direct and indirect pollutant water release estimates (pounds per year) reported to TRI. Due to TRI reporting requirements, the TRI dataset does not include flow rate information or underlying pollutant concentrations. However, facilities do report a basis of estimate (BOE) indicator to TRI. The BOE indicator provides a general indication of how the facility estimated its reported water release data. For instance, a BOE of "M1" or "M2" indicates the reported releases are based on monitoring data, a BOE of "C", "E1", or "E2" indicates the reported releases are based on mass balance calculations or emission estimates (U.S. EPA, 2014).

Although TRI and DMR data do not identify the effluent limitations guidelines and standards (ELGs) applicable to a particular facility, TRI classifies facilities based on industrial activity according to facility North American Industry Classification System (NAICS) codes, while ICIS-NPDES classifies facilities by Standard Industrial Classification (SIC) codes. The Water Pollutant Loading Tool relates each facility to a point source category using two established crosswalks that EPA developed for the purpose of its annual reviews:[1] "SIC/Point Source Category Crosswalk" and "NAICS/Point Source Category Crosswalk."[2]

The Water Pollutant Loading Tool also applies a pollutant-specific toxic weighting factor (TWF)[3] to the annual pollutant loads to calculate the relative toxic-weighted pound equivalents (TWPE) for each pollutant and total TWPE for all pollutants discharged at each facility.[4] The Water Pollutant Loading Tool then sums the total TWPE for the facilities in a particular point source category to provide a total TWPE for the category. EPA uses the TWPE to compare the relative toxicity of the point source categories and identify the pollutants and facilities within a category that are major contributors to the category's toxic discharges. As part of this review, EPA incorporated several revised TWFs into the Water Pollutant Loading Tool, as discussed in Section 2.1.1.

EPA also performed a quality review of the DMR and TRI data, as described in Section 2.1.2. EPA then imported the DMR and TRI data into a set of static databases, as described in Section 2.1.3. EPA used these static databases, as described in Section 2.1.4, to identify and/or obtain pollutant discharge concentration data. These databases formed the basis for EPA's analyses in the continued category reviews presented in Sections 4, 5, and 6.

For more information on the DMR and TRI data sources and the utility and limitations of their use in EPA's annual reviews, see Section 2.1 of the 2015 Annual Review Report (U.S. EPA, 2016a).

2.1.1 Toxic Weighting Factor Updates

During this review, EPA updated TWFs for seven chemicals: arsenic, cadmium, copper, manganese, mercury, thallium, and vanadium. These TWF revisions, shown in Table 2-1, are consistent with TWF revisions that EPA made as part of the Steam Electric Power Generating rulemaking in 2015 (ERG, 2015). EPA incorporated the TWF revisions into the Water Pollutant Loading Tool prior to downloading the 2014 DMR and TRI data. EPA did not develop new TWFs for chemicals that did not previously have a TWF (U.S. EPA, 2016b).

Table 2-1. Revised TWFs

Pollutant	TWF Calculation Update	Previous TWF	Revised TWF
Arsenic	Revised CPF.	4.04	3.47
Cadmium	Revised RfD (diet-based).	23.1	22.8
Copper	Revised BCF.	0.635	0.623

[1] For more information on how EPA relates each SIC and NAICS code to an industrial category, see Section 5.0 of the *Technical Support Document for the Annual Review of Existing Effluent Guidelines and Identification of Potential New Point Source Categories* (2009 Screening-Level Analysis (SLA) Report) (U.S. EPA, 2009).

[2] These crosswalks are available with the Water Pollutant Loading Tool documentation: https://cfpub.epa.gov/dmr/technical-support-documents.cfm.

[3] For more information on TWFs, see Toxic Weighting Factors Methodology (U.S. EPA, 2012a).

[4] Consistent with the methodology presented in the 2009 SLA Report (U.S. EPA, 2009).

Table 2-1. Revised TWFs

Pollutant	TWF Calculation Update	Previous TWF	Revised TWF
Iron	Revised RfD – EPA does not have a BCF to use in the HH calculation; therefore, RfD update does not change the TWF.	0.00560	0.00560
Manganese	Revised AQ benchmark.	0.0704	0.103
Mercury	Revise the fish consumption rate used to calculate HH for mercury to 0.0175 kg/day (same as other pollutants using the 2000 Methodology).	117	110
Thallium	Revised AQ benchmark; use the 2000 methodology. NRWQC updated in 2003 (U.S. EPA, 2003).	1.03	2.85
Vanadium	Revised AQ benchmark. Revised RfD – EPA does not have a BCF to use in the HH calculation; therefore, RfD update does not affect the TWF.	0.035	0.280

Source: (ERG, 2015)

Acronyms: AQ (aquatic life value); BCF (bioconcentration factor); CPF (cancer potency factor); HH (human health value); NRWQC (National Recommended Water Quality Criteria); RfD (reference dose); TWF (toxic weighting factor).

2.1.2 DMR and TRI Data Quality Review

Consistent with its methodology in previous annual reviews, and as described above, EPA downloaded the DMR and TRI data from the Water Pollutant Loading Tool. EPA conducted a general quality review of the completeness, accuracy, and reasonableness of the DMR and TRI data for the entire dataset. EPA then conducted a more focused quality review of the DMR and TRI data for the specific industry categories and pollutants evaluated during this review.

The *Technical Users Background Document for the Discharge Monitoring Report (DMR) Pollutant Loading Tool* (DMR Loading Tool Technical Users Document) describes the underlying ICIS-NPDES data extraction and calculation procedures used in the Water Pollutant Loading Tool. Section 5 of the DMR Loading Tool Technical Users Document describes the specific quality control procedures, which include completeness, comparability, accuracy, and reasonableness checks to identify and address any quality issues. The Water Pollutant Loading Tool extracts ICIS-NPDES data and calculates loadings on a weekly basis. Routine quality control procedures that are part of the weekly refresh include flagging potential outliers, and autocorrecting misreported units and unreasonable flow values (U.S. EPA, 2012b).

Similarly, the TRI program maintains data quality procedures to ensure that the reported TRI data are accurate and reliable. For example, each year the TRI data are analyzed for potential errors and the program may contact facilities concerning potentially inaccurate data. EPA's TRI program also provides instructions and guidance on facility reporting requirements (U.S. EPA, 2016c). The Water Pollutant Loading Tool extracts the TRI data on a yearly basis after they have been fully reviewed by the TRI program.

Though the underlying DMR and TRI datasets are routinely evaluated for data quality, EPA conducted additional data quality review steps to further evaluate the completeness, accuracy, and reasonableness of the relevant DMR and TRI data. The *Environmental*

Engineering Support for Clean Water Regulations Programmatic Quality Assurance Project Plan (PQAPP) describes the quality objectives in more detail (ERG, 2013). The sections below summarize EPA's additional data quality review steps performed for this review.

2.1.2.1 Data Quality Review and Corrections to the DMR Data

General quality review steps completed for the DMR data include checks for completeness, accuracy, and reasonableness across the entire DMR dataset, described below.

Completeness. To evaluate the data's completeness, EPA compared counts of facilities reporting DMR loadings data in the Water Pollutant Loading Tool in recent years, as shown in Table 2-2.

As discussed in the 2015 Annual Review Report, New Jersey has not converted to the current DMR data system (ICIS-NPDES), and thus, has not supplied EPA with required data about its NPDES discharge program since 2012 (U.S. EPA, 2016a). As a result, the DMR data are not complete nationwide. However, because the numbers of major and minor facilities reporting DMR data are otherwise similar between 2013 and 2014, EPA determined that the DMR data, as contained in the Water Pollutant Loading Tool, were usable for this review.[5]

Table 2-2. Results of the DMR Data Completeness Check

Number of Major Industrial Dischargers		Number of Minor Industrial Dischargers	
DMR 2013	DMR 2014	DMR 2013	DMR 2014
1,938	1,849	16,420	16,556

Sources: *DMRLTOutput2013_v1* and *DMRLTOutput2014_v1*.

Accuracy and reasonableness. To evaluate the accuracy and reasonableness of the DMR loadings data, EPA reviewed the database corrections from previous annual reviews to decide whether they should apply to the 2014 DMR discharges.

The Enforcement and Compliance History Online (ECHO) website[6] allows users of EPA datasets to identify and report DMR data updates and corrections through an integrated Error Report tool. Once submitted, error reports are routed to the appropriate EPA and State data stewards for evaluation and correction. As part of this review, EPA also reviewed the facility and pollutant discharges that had the greatest impact on total category loads in the Water Pollutant Loading Tool, based on toxic-weighted pounds discharged, to identify potential outliers. EPA reported potential DMR data outliers through the ECHO Error Report system for the data stewards to investigate and resolve. Any corrected data in ICIS-NPDES are automatically pulled into the Water Pollutant Loading Tool.

[5] Major discharges usually have the capability to impact receiving waters if not controlled and, therefore, have received more regulatory attention than minor discharges (U.S. EPA, 2010).

[6] See EPA's Enforcement Compliance History Online.

2.1.2.2 Data Quality Review and Corrections to the TRI Data

General quality review steps completed for the TRI water release data include checks for completeness, accuracy, and reasonableness across the entire TRI dataset, described below.

Completeness. To evaluate the data's completeness, EPA compared counts of facilities reporting TRI data in the Water Pollutant Loading Tool in recent years, as shown in Table 2-3. Because the number of facilities reporting is similar between 2013 and 2014, EPA determined that the TRI data contained in the Water Pollutant Loading Tool were useable for this review.

Table 2-3. Results of the TRI Data Completeness Check

Total Number of Facilities Reporting to TRI		Number of Facilities Reporting Discharges Greater than Zero to TRI	
TRI 2013	TRI 2014	TRI 2013	TRI 2014
19,601	19,986	6,936	7,067

Sources: *TRILTOutput2013_v1* and *TRILTOutput2014_v1*.

Accuracy and reasonableness. To evaluate the accuracy and reasonableness of the TRI data, EPA reviewed the database corrections from previous annual reviews to decide whether corrections made during previous reviews should apply to the 2014 TRI releases. EPA also verified that the Water Pollutant Loading Tool excluded pollutants that should not have an associated pollutant load (e.g., yellow or white phosphorus), as described in further detail in Section 3.4.2 in EPA's *2011 Annual Effluent Guidelines Review Report* (U.S. EPA, 2012c).

2.1.3 Generation of the DMR and TRI Databases

After they were downloaded and reviewed for quality, EPA incorporated the TRI and DMR data into a set of databases, described below, which are designed to preserve the integrity of the data and to support subsequent analyses integral to this review. These databases are static, while the Water Pollutant Loading Tool is based on a dynamic dataset that can change over time. For example, evolving reporting requirements may affect the population of facilities reporting to ICIS-NPDES and facilities may report data corrections as they are identified.

Consistent with previous annual reviews, EPA created the *DMRLTOutput2014_v1* and *TRILTOutput2014_v1* databases to aid in its review of the DMR and TRI pollutant loading data. EPA describes these databases below:

- *DMRLTOutput2014_v1* (DCN 08408): 2014 pollutant loadings (pounds per year) and TWPE for industrial facilities, calculated based on DMR data.
- *TRILTOutput2014_v1* (DCN 08409): 2014 direct and indirect water releases (pounds per year) and TWPE for industrial facilities, including a facility-reported BOE indicator.

2.1.4 Methodology for Obtaining Pollutant-Specific Concentration Data

For its continued reviews of the Iron and Steel Manufacturing, OCPSF, and Pulp and Paper point source categories, EPA also evaluated discharge (effluent) concentrations of a specific subset of pollutants identified for further review during the 2015 Annual Review (U.S.

EPA, 2016a).[7] As described in Section 2.1, concentration and flow rate information are not available in TRI. Therefore, EPA used 2014 DMR data to assess the pollutant-specific concentrations from direct discharges. For each of the three point source categories, EPA extracted available 2014 DMR concentration data from the Water Pollutant Loading Tool into a static database, *DMRLTConcOutput2014_v1* (DCN 08407) for further analysis.

Because some of the pollutants identified for further review are not regulated by the ELGs, limited DMR data are available. In addition, as described in 2.1, DMR data do not provide information regarding indirect discharges. To obtain additional information on direct and indirect pollutant discharge concentrations, EPA identified facilities that reported releases of the pollutants to TRI in 2014, focusing on those facilities that used monitoring data to estimate their reported releases. To obtain underlying concentration data for pollutants and facilities that were not represented in DMR data, EPA contacted several facilities that reported direct and/or indirect releases to TRI but did not have corresponding DMR data.

Sections 2.1.4.1 and 2.1.4.2 below describe EPA's general methodology for obtaining direct and indirect discharge concentration data, respectively. Section 4 describes EPA's methodology for reviewing concentration data for the three point source categories and pollutants identified for further review, including a list of facilities EPA contacted for each of the continued category reviews.

2.1.4.1 Direct Discharge Concentrations

EPA followed the steps below to evaluate DMR and obtain TRI direct discharge facility effluent concentration data for the relevant point source categories identified for further review (Iron and Steel, OCPSF, and Pulp and Paper).

1. *DMR Direct Discharge Concentration Data.* From *DMRLTConcOutput2014_v1*, EPA identified all external facility outfalls with monitoring-period-specific concentration data for each of the pollutants identified for further review.[8] A facility's permit specifies the frequency of concentration measurements, indicated by the monitoring period, e.g., daily, monthly, quarterly, biannually, or annually. Facilities may submit minimum, average, and/or maximum concentrations on their DMRs, depending on the type of limits in a permit. Facilities commonly submit monthly average and/or daily maximum concentrations. For the purposes of this review, EPA used minimum and monthly average concentration data.[9] EPA performed the following calculations on the concentration data:

    a. A facility may indicate a concentration submitted on a DMR as below the detection limit. In these cases, EPA used half of the detection limit as the

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[7] Pollutants identified for further review are: lead, nitrate, copper, and manganese discharges in the Iron and Steel Manufacturing Category, total residual chlorine and nitrate discharges in the OCPSF Category, and lead, mercury, manganese, and hydrogen sulfide discharges in the Pulp and Paper Category.

[8] EPA did not use quantity data from *DMRLTConcOutput2014_v1* in its analyses.

[9] EPA used minimum concentration data for total residual chlorine discharges from OCPSF facilities only. See Section 4.2 for further details. EPA used monthly average concentration data for the remaining pollutants identified for review in the Iron and Steel, OCPSF, and Pulp and Paper categories.

monthly average concentration, consistent with EPA's annual review methodology for handling non-detect data (U.S. EPA, 2016d).[10]

b. EPA calculated an average yearly pollutant concentration specific to each outfall, based on reported monthly or quarterly average concentration data.

2. *TRI Direct Discharge Concentration Data*. Because flow rates and pollutant concentrations are not available in TRI, EPA contacted several facilities to obtain the underlying concentration data that formed the basis for their reported releases. For context, EPA also requested relevant information on process operations and wastewater treatment at the facilities. EPA identified facilities to contact using the following steps:

   a. From *TRILTOutput2014_v1*, EPA identified the facilities that reported direct releases of the pollutants identified for further review and that use monitoring data to estimate TRI releases. The use of monitoring data is indicated by a basis of estimate code of "M1" (estimate based on continuous monitoring data or measurements for the EPCRA section 313 chemical), or "M2" (estimate based on periodic or random monitoring data or measurements for the EPCRA section 313 chemical) (U.S. EPA, 2014).

   b. From *DMRLTOutput2014_v1*, EPA identified facilities that reported discharges of the pollutants identified for further review.[11]

   c. EPA identified facilities reporting direct releases of the pollutants to TRI in 2014 (from Step a) that did not report 2014 DMR discharges for the same pollutants (from Step b).

   d. EPA contacted a subset of facilities reporting each pollutant to TRI, based on facilities that 1) reported the highest releases to TRI, 2) use monitoring data to estimate TRI releases (identified from step a), and 3) do not have corresponding DMR data (identified from step c). EPA requested the underlying pollutant concentration data from these facilities, along with information on process operations that may result in releases and current treatment for the pollutant(s).

3. EPA compiled all 2014 concentration data obtained from DMRs and contacts with facilities reporting to TRI into separate spreadsheets for the Iron and Steel Manufacturing, OCPSF, and Pulp and Paper point source categories to facilitate the analyses described in Section 4 (ERG, 2016a, 2016b, 2016c).

[10] The Water Pollutant Loading Tool handles non-detect data similarly when calculating loadings using concentration and flow data.
[11] EPA did not use the *DMRLTConcOutput2014_v1* database as part of reviewing the TRI direct discharge data.

2.1.4.2 Indirect Discharge Concentrations

EPA followed the steps below to obtain effluent concentration data for facilities discharging to publicly owned treatment works (POTWs) for the point source categories identified for further review (Iron and Steel, OCPSF, and Pulp and Paper). TRI provides the only readily available source of information on indirect discharges.

1. *TRI Indirect Discharge Concentration Data.* Because flow rates and pollutant concentrations are not available in TRI, EPA contacted a subset of facilities reporting indirect releases to obtain the underlying concentration data. EPA identified facilities to contact using the following steps:

    a. From *TRILTOutput2014_v1,* EPA identified facilities that report indirect releases of pollutants identified for further review and that use monitoring data to estimate TRI releases, as indicated by a basis of estimate code of "M1" or "M2."

    b. EPA contacted a subset of facilities reporting each pollutant to TRI (identified from step a) to obtain underlying pollutant concentration data, along with information on process operations and current treatment for the pollutant(s) at the facilities before discharge to the POTW.

2. EPA compiled all 2014 indirect discharge concentration data obtained through contacts with facilities reporting to TRI into separate spreadsheets for the Iron and Steel Manufacturing, OCPSF, and Pulp and Paper point source categories to facilitate the analyses described in Section 4 (ERG, 2016a, 2016b, 2016c).

2.1.5 References for DMR and TRI Data Sources and Quality Review

1. ERG. (2013). Eastern Research Group, Inc. *Environmental Engineering Support for Clean Water Regulations Programmatic Quality Assurance Project Plan (PQAPP).* Chantilly, VA. (May). EPA-HQ-OW-2010-0824-0229.

2. ERG. (2015). Eastern Research Group, Inc. *Memorandum from Jill Lucy, Eastern Research Group, Inc. to Bill Swietlik, U.S. EPA. RE: Review of Toxic Weighting Factors in Support of the Final Steam Electric Effluent Limitations Guidelines and Standards (DCN SE04479).* Chantilly, VA. (September 21). EPA-HQ-OW-2015-0665. DCN 08404.

3. ERG. (2016a). Eastern Research Group, Inc. *Continued Preliminary Category Review – Facility Data Review and Calculations for Point Source Category – 414 – Organic Chemicals, Plastics and Synthetic Fibers.* Chantilly, VA. (September). EPA-HQ-OW-2015-0665. DCN 08486.

4. ERG. (2016b). Eastern Research Group, Inc. *Continued Preliminary Category Review – Facility Data Review and Calculations for Point Source Category – 420 –Iron and Steel Manufacturing.* Chantilly, VA. (September). EPA-HQ-OW-2015-0665. DCN 08429.

5. ERG. (2016c). Eastern Research Group, Inc. *Continued Preliminary Category Review – Facility Data Review and Calculations for Point Source Category – 430 – Pulp, Paper and Paperboard.* Chantilly, VA. (September). EPA-HQ-OW-2015-0665. DCN 08462.

6. U.S. EPA. (2009). *Technical Support Document for the Annual Review of Existing Effluent Guidelines and Identification of Potential New Point Source Categories.* Washington, D.C. (October). EPA-821-R-09-007. EPA-HQ-OW-2008-0517-0515.

7. U.S. EPA. (2010). *U.S. EPA NPDES Permit Writers' Manual*. Retrieved from http://www3.epa.gov/npdes/pubs/pwm_2010.pdf. Washington, D.C. (September). EPA-833-K-10-001. EPA-HQ-OW-2010-0824-0236.

8. U.S. EPA. (2012a). *Toxic Weighting Factors Methodology*. Washington, D.C. (March). EPA-820-R-12-005. EPA-HQ-OW-2010-0824-0004.

9. U.S. EPA. (2012b). *Technical Users Background Document for the Discharge Monitoring Report (DMR) Pollutant Loading Tool Version 1.0*. Retrieved from http://cfpub.epa.gov/dmr/docs/Technical_Users_Background_Doc.pdf. Washington, D.C. (January). EPA-HQ-OW-2014-0170-0203.

10. U.S. EPA. (2012c). *The 2011 Annual Effluent Guidelines Review Report*. Washington, D.C. (December). EPA-821-R-12-001. EPA-HQ-OW-2010-0824-0195.

11. U.S. EPA. (2014). *Toxic Chemical Release Inventory Reporting Forms and Instructions, Revised 2014 Version*. Washington, D.C. (December). EPA 260-R-15-001. EPA-HQ-OW-2015-0665. DCN 08405.

12. U.S. EPA. (2016a). *The 2015 Annual Effluent Guidelines Review Report*. Washington, D.C. (June). EPA-821-R-16-002. EPA-HQ-OW-2015-0665-0299.

13. U.S. EPA. (2016b). *DMR Parameter and TRI Chemical Toxic Weighting Factors.* Washington, D.C. (September). EPA-HQ-OW-2015-0665. DCN 08406.

14. U.S. EPA. (2016c). Toxics Release Inventory Data Quality. Washington, D.C. Retrieved from https://www.epa.gov/toxics-release-inventory-tri-program/tri-data-quality. Accessed: September, 2016. EPA-HQ-OW-2015-0665. DCN 08411.

15. U.S. EPA. (2016d). *Memorandum from William Swietlik, U.S. EPA, to Public Docket for the Preliminary 2016 Effluent Guidelines Program Plan, EPA Docket Number EPA-HQ-OW-2015-0665. Re: Summary of Methodology for Handling Non-Detect Data: 304m and Steam Electric Power Generating*. (February 16). EPA-HQ-OW-2015-0665-0284.

2.2 Methodology for Comparing Canada's National Pollutant Release Inventory and the U.S. Toxics Release Inventory Pollutant Data

EPA compared available pollutant release data and reporting requirements from the U.S. TRI to the Canadian NPRI. The goal of this analysis was to identify potential additional pollutants that may be present in industrial wastewater discharges from iron and steel manufacturing, OCPSF, and pulp and paper facilities, but are not currently captured in EPA's data sources (i.e., TRI). Specifically, EPA identified the pollutants reported in both TRI and NPRI, as well as pollutants reported only in NPRI but not in TRI, for these specific point source categories. For pollutants reported only in NPRI, EPA compared the reporting requirements of the two programs to understand the reporting differences (e.g., differences/similarities in the reporting thresholds; inclusion of the same individual chemical compounds within groups of reportable chemicals, etc.). In addition, EPA compared the number of facilities reporting specific pollutants to NPRI to the total number of facilities reporting any water releases to NPRI, within a specific industry category, to provide an indication of each pollutant's potential prevalence in industrial wastewater throughout an industry category.

Section 2.2.1 provides background on the TRI and NPRI programs and their reporting requirements. Section 2.2.2 discusses EPA's data quality review of the TRI and NPRI data. Section 2.2.3 details EPA's methodology for obtaining and processing the NPRI data and compares the NPRI and TRI data for the three point source categories identified above. Sections 4.1, 4.2, and 4.3 include details on the specific NPRI and TRI comparison analyses and evaluations relevant to the Iron and Steel Manufacturing, OCPSF, and Pulp and Paper point source categories, respectively.

For more information on this comparative analysis, including a detailed summary of the TRI and NPRI reporting requirements and EPA's steps for comparing the TRI and NPRI data, see the memorandum *Comparison of Canada's National Pollutant Release Inventory and the Toxics Release Inventory Pollutant Data by Category for the Effluent Guidelines Planning Review Report Supporting the Final 2016 Effluent Guidelines Program Plan* (ERG, 2015).

2.2.1 TRI and NPRI Background and Overview of Reporting Requirements

Section 313 of the Emergency Planning and Community Right-to-Know Act requires facilities meeting specified thresholds to report to TRI their annual releases and other waste management activities for listed toxic chemicals. Facilities must report the quantities of toxic chemicals recycled, collected, combusted for energy recovery, treated for destruction, or otherwise disposed. Facilities must complete a separate report for each chemical manufactured, processed, or used in excess of the reporting threshold. EPA uses water release data reported annually to TRI in the ELG planning process as described in Section 2.1.

The NPRI is Canada's legislated, publicly accessible inventory of pollutant releases to air, water, and land; disposals; and transfers for recycling. The Canadian Environmental Protection Act 1999 requires facilities that manufacture, process, or otherwise use or release certain substances, and that meet reporting thresholds and other requirements to report their pollutant releases, disposals, and transfers annually to NPRI. In recent years, approximately 8,000 facilities report to NPRI (Environment Canada, 2013).

Table 2-4 provides a summary of the reporting requirements of TRI and NPRI.

Table 2-4. Reporting Requirements of TRI and NPRI

Inventory	Summary of Reporting Requirements	Chemical Universe
TRI	Facilities must meet three criteria to report to TRI:[a] • Be covered under a specific set of NAICS codes (related to mining, utilities, manufacturing, merchant wholesalers, wholesale electronic markets, publishing, hazardous waste, federal facilities). • Have 10 or more full-time employee equivalents. • Manufacture, process, or otherwise use any of the listed chemicals above an activity threshold (e.g., 25,000 pounds for non PBT chemicals).	• The TRI chemical list contains 688 reportable chemicals or chemical groups [b] • TRI requires reporting based on mass thresholds. • The 2013 TRI data include direct and indirect water releases associated with 256 of the 688 chemicals.[c]
NPRI	Facilities must meet one of the following criteria and the mass or concentration thresholds for one or more of the listed NPRI substances to report to NPRI:[d] • Have 10 or more employees, or • Perform certain activities, including incineration, wood preservation/pressure treatment, terminal operations, wastewater collection, pits and quarries operation, or pipeline installation.	• The NPRI Substance List contains 366 reportable chemicals.[e] • NPRI requires reporting based on the mass or concentration thresholds. • The 2013 NPRI data include direct and indirect water releases associated with 111 of the 366 reportable chemicals.[f]

Note: EPA relied on TRI and NPRI data for reporting year 2013 because those were the most recent data available on the same year basis in both data sets when the review began.

[a] Source: (U.S. EPA, 2016)

[b] Sources: (U.S. EPA, 2015a, 2015b)

[c] Source: *TRILTOutput2013_v1*

[d] Source: (Environment Canada, 2015a)

[e] Sources: (Environment Canada, 2014a)

[f] Source: (Environment Canada, 2014b)

2.2.2 TRI and NPRI Data Quality Review

For the initial TRI/NPRI comparison, EPA relied on TRI and NPRI data for reporting year 2013 because those were the most recent data available on the same year basis in both data sets when the review began. As part of its annual reviews, EPA routinely evaluates the utility and limitations of the TRI data. As part of the 2015 Annual Review, EPA completed a quality review of 2013 TRI data to identify and correct any outliers. See Sections 2.1.5 and 2.2 of EPA's 2015 Annual Review Report for a discussion of TRI data utility, limitations, quality review, and data corrections (U.S. EPA, 2016).

EPA's evaluation of the utility, limitations, and quality of the NPRI data, as they pertain to the TRI/NPRI data comparison, can be found in the *Comparison of Canada's National Pollutant Release Inventory and the Toxics Release Inventory Pollutant Data by Category for the Effluent Guidelines Planning Review Report Supporting the Final 2016 Effluent Guidelines Program Plan* memorandum (ERG, 2015). EPA presents a summary of the NPRI data utility and limitations below. The utility and limitations of the NPRI data are similar to TRI; therefore, the datasets can be readily compared.

2.2.2.1 NPRI Data Utility

In order to compare the NPRI data to the TRI data for use in the ELG planning process, EPA evaluated the utility and limitations of the NPRI data. Like the TRI data, the data collected in NPRI are useful for this comparison for the following reasons:

- NPRI is national in scope, including data from facilities across Canada.
- NPRI includes industrial releases to municipal sewage treatment plants (indirect releases), not just direct releases to surface water.
- NPRI identifies facilities by NAICS code, which can be used to match the data in TRI and facilitate the analysis of reporting differences and potential gaps in the TRI data associated with specific industrial categories.
- NPRI includes release data from many industrial categories.

2.2.2.2 NPRI Data Limitations

Similar to the TRI data, the limitations of the data collected in NPRI include the following (Environment Canada, 2015b):

- Many small establishments (fewer than 10 full-time equivalent employees) are not required to report (unless they meet another reporting criterion), nor are facilities that do not meet the reporting thresholds. Additionally, reporting is not required for any particular NAICS codes. Thus, facilities reporting to NPRI may be a subset of an industry.
- Release reports are, in part, based on estimates, not measurements. Facilities may use a number of methods to report releases, including estimating and direct measurement.
- NPRI only requires facilities to report certain chemicals; therefore, all chemicals discharged from a facility may not be captured.

2.2.3 General Data Processing Steps for the TRI/NPRI Comparison

As described in detail in the memorandum *Comparison of Canada's National Pollutant Release Inventory and the Toxics Release Inventory Pollutant Data by Category for the Effluent Guidelines Planning Review Report Supporting the Final 2016 Effluent Guidelines Program Plan* (ERG, 2015), EPA performed the following data processing steps on the 2013 TRI and NPRI data to compare the data:

- Obtained the 2013 TRI data from its *TRILTOutput2013_v1* database (DCN 08120) developed during the 2015 Annual Review (U.S. EPA, 2016).
- Downloaded the 2013 NPRI data from Environment Canada's NPRI website (Environment Canada, 2014b).
- Compiled the TRI and NPRI data into a common database, *NPRICompare2013* (DCN 08410).

- Identified and isolated releases to water.
- Identified facilities with reported pollutant releases to water greater than zero.
- Linked facility NAICS codes in both inventories to EPA's Industrial Point Source Categories.

Upon completing the data processing steps described above, EPA compared the NPRI and TRI data for the OCPSF, Iron and Steel Manufacturing, and Pulp and Paper point source categories to gauge the potential utility of the subsequent analyses. Table 2-5 compares the number of facilities and unique chemicals reported in each dataset for each point source category. As shown, although TRI contains information from many more facilities than NPRI in all of the three categories, in two of the three point source categories, NPRI and TRI contain data for a similar number of unique chemicals. Section 4 presents the results of the subsequent category-specific NPRI analyses.

Table 2-5. Facilities and Chemicals Listed in TRI and NPRI for Three Point Source Categories

PSC Code	Point Source Category	Number of Facilities		Number of Unique Chemicals	
		TRI	NPRI	TRI	NPRI
414	Organic Chemicals, Plastics, and Synthetic Fibers	647	43	174	42
420	Iron and Steel Manufacturing	215	19	41	45
430	Pulp, Paper, and Paperboard	226	69	43	41

Sources: *TRIOutput2013_v1*; *NPRICompare2013*

2.2.4 References for Methodology for Comparing Canada's National Pollutant Release Inventory and the U.S. Toxics Release Inventory Pollutant Data

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3. PUBLIC COMMENTS ON THE PRELIMINARY 2016 EFFLUENT GUIDELINES PROGRAM PLAN

EPA's annual review process considers information provided by the public and other stakeholders regarding the need for new or revised effluent limitations guidelines and standards (ELGs). Public comments received on EPA's prior reviews and plans helps the Agency prioritize its analysis of existing ELGs. This section presents a summary of the public comments and stakeholder input received on the *Preliminary 2016 Effluent Guidelines Program Plan* (Preliminary 2016 Plan).

3.1 Public Comments and Stakeholder Input

EPA published its Preliminary 2016 Plan and provided a 30-day public comment period starting on June 27, 2016 (see 81 FR 41535). The Docket supporting the *Final 2016 Effluent Guidelines Program Plan* (Final 2016 Plan) includes a complete set of the comments submitted, as well as the Agency's responses (see DCN 08521). EPA received 11 comment letters on the Preliminary 2016 Plan, representing 20 organizations. Table 3-1 presents a summary of these comments.

Commenting organizations representing industry included:

- United States Steel Corporation (U.S. Steel)
- American Exploration & Production Council (AXPC)
- American Petroleum Institute (API)
- The American Iron and Steel Institute (AISI)[12]
- Steel Manufacturers Association (SMA)
- Specialty Steel Industry of North America (SSINA)
- American Forest & Paper Association (AF&PA)

Commenting organizations representing environmental organizations included:

- Environmental Defense Fund (EDF)
- Clean Water Action[13]
- Environmental Integrity Project
- Partnership for Policy Integrity
- Sierra Club
- Delaware Riverkeeper Network
- Natural Resources Defense Council
- Upper Burrell Citizens Against Marcellus Pollution (UBCAMP)

[12] Three steel associations, AISI, SMA, and SSINA, collectively submitted public comments on the Preliminary 2016 Plan in one comment letter.

[13] Eight environmental organizations submitted public comments on the Preliminary 2016 Plan collectively in one comment letter. EDF was the only environmental organization to submit a separate public comment.

- Earthworks

Additionally, one non-profit trade association, Water Environment Federation (WEF), one organization representing publicly owned treatment works (POTWs), the National Association of Clean Water Agencies (NACWA), and two municipal entities, the Metropolitan Sewer District of Greater Cincinnati Industrial Waste Section (District), and the Orange County Sanitation District (Sanitation District), submitted comments.

EPA received seven comments on its proposed centralized waste treatment (CWTs) detailed study from two municipal entities, an organization representing POTWs, a non-profit trade association, two industry trade associations, and eight environmental organizations. The industry trade associations urged EPA to consider the study in the context of the newly revised ELGs for the Oil and Gas Extraction Category, and to recognize the benefits and importance of CWTs as one of the few options for wastewater management for the oil and gas industry. They also urged EPA to limit the study to those facilities defined as CWTs within 40 CFR Part 437, taking care to target the facilities that accept oil and gas wastewater, not the generators of the wastes accepted by the facilities. One of the industry trade associations also indicated that EPA must be more forthcoming about information related to the study, at a minimum including in the effluent guidelines plan the key criteria for the CWTs that are subject to the study.

The environmental organizations supported EPA's continuation of a detailed study of CWTs that accept oil and gas wastewaters and requested the study be expedited. The environmental organizations stated that the CWT ELGs are out of date due to developments in oil and gas exploration, changes in pollutants associated with stimulation and extraction techniques, and dramatic increases in produced water. In addition, the organizations indicated that CWTs may not have treatment in place for harmful constituents in oil and gas wastewaters such as radionuclides. Further, the organizations expressed concern regarding the potential increase in oil and gas wastewater sent to CWTs as a result of the revised ELGs for the Oil and Gas Extraction Category related to unconventional oil and gas extraction wastewater. The environmental organizations also provided information related to the Center for Sustainable Shale Development Discharge Standard and produced water volumes and discharge practices at CWTs.

The non-profit trade association, a municipal entity, and the organization representing POTWs indicated that EPA should reevaluate the scope and applicability of the CWT ELGs due to emerging markets for wastewater disposal. This would provide POTWs with valuable waste characterization information and an opportunity to expand the regulation to all waste types processed by a CWT operation. These organizations also commented EPA should address the Initial and Period Certification Statements dealing with dilution, non-limited pollutants of concern, and CWT wastes bypassing treatment but later combined for discharge, resulting in dilution. The non-profit organization, a municipal entity, and one environmental organization provided comment and information regarding CWT best management practices (BMPs) that EPA should consider.

EPA received three comments on its proposed continued preliminary review of the Metal Finishing Category (40 CFR Part 433) from a non-profit trade association, and two municipal entities. All three organizations supported EPA's continued study of the metal finishing industry.

The non-profit trade association and one of the municipal entities recommended adding pretreatment standards for 1,4-dioxane and N-Nitrosodimethylamine (NDMA), due to their impact on POTWs that may be engaged in resource recovery (direct and indirect water reuse and recycling), as well as the potential hazard to human health. The other municipal entity indicated that EPA should expand certain definitions and terminology in 40 CFR Part 433, such as phosphate conversion coating, passivation, and brush plating, and define new sources such as wet air pollution controls, new operations, and treatment and recycling technologies, to clarify the applicability of the existing ELG.

EPA received three comments regarding its request in the Preliminary 2016 Plan for new data and information on known transfers of wastewater originating from conventional oil and gas extraction facilities to POTWs; one comment from an industry trade association and two comments representing nine environmental organizations. The environmental organizations generally supported EPA's request for additional data regarding these transfers and provided information on the known volumes and characteristics of pollutants discharged to POTWs. The environmental organizations also supported EPA's request for information on well treatment and workover fluids in produced water. The industry trade association did not provide information about known discharges of conventional oil and gas wastewaters to POTWs, volumes, and/or characteristics, and they questioned EPA's request for information on conventional extraction and produced water discharges in the oil and gas industry. The industry trade association indicated that the distinction between conventional and unconventional oil and gas wastewater and activities is arbitrary, impractical, and problematic, and that EPA should have requested and reviewed information on conventional oil and gas extraction wastewater before issuing the rule related to unconventional oil and gas extraction wastewater. They further urged EPA to reach out to the oil and natural gas industry with questions, going forward.

EPA received two comments, representing four industry trade associations, on its review of the Iron and Steel Manufacturing Category (40 CFR Part 420). The industry trade associations did not support EPA's further review of the Iron and Steel Manufacturing Category, stating that the existing ELGs adequately control lead, and that revised guidelines for nitrate, manganese/manganese compounds and copper/copper compounds are not warranted. Further, they concurred with EPA's results that no further review is warranted for polychlorinated biphenyls (PCBs), cyanide, and fluoride because the discharge monitoring report (DMR) discharges from facilities are not representative of the effluent from facilities in the Iron and Steel Manufacturing Category (the discharges can be attributed to only a few facilities). The industry trade associations also suggested that EPA accept further comments on the Preliminary 2016 Plan and/or coordinate with the industry on any further reviews going forward.

EPA received comments from one industry trade association regarding its recently revised rule addressing wastewater discharges from unconventional oil and gas extraction (under 40 CFR Part 435). The organization urged EPA to abandon the distinction between produced water by conventional and unconventional formations and to take a holistic approach to the evaluation of produced water treatment regardless of formation characteristics. The industry trade association asserted that EPA's definition of "unconventional" is not necessarily consistent with various state or industry definitions and terminology, and that the definition of shale or tight formations is unclear, which may lead to confusion about what can be discharged to a POTW. The industry trade association urged EPA to withdraw the ELGs related to unconventional oil and gas extraction wastewater because EPA developed the definitions without collaborating with the impacted industry, states, or other stakeholders, and is only now soliciting information on conventional oil and gas extraction wastewaters after the publication of the ELGs related to unconventional oil and gas extraction. Further, the organization remains opposed to the permanent removal of the option to send unconventional oil and gas wastewater to POTWs, as this has the potential, in different economic circumstances and/or with the advent of improved treatment technologies, to become a viable alternative for the industry.

EPA received one comment from industry regarding its study of the Petroleum Refining Category (40 CFR Part 419). The industry trade association suggested that EPA provide a clear, data-supported justification for proceeding with the detailed study or discontinue the study. The commenter also encouraged EPA to engage petroleum refinery trade associations and stakeholders more fully if the study is to continue.

One industry trade association representing the pulp and paper industry expressed appreciation for EPA's efforts to collaboratively work with industry in reviewing the pollutants of concerned identified in the annual review.

EPA received one comment from a municipal entity in support of EPA's continued study of sapphire crystals and the applicability of the Electrical and Electronic Components Category (40 CFR Part 469) ELGs to sapphire crystals.

EPA received one set of comments from eight environmental organizations indicating that EPA's decision to delist Coalbed Methane Extraction from the ELG Plan was premature and suggesting that EPA reconsider in light of shifting gas prices, demand, and costs of wastewater treatment.

Lastly, EPA received three comments regarding its investigation of other point source categories not specifically mentioned in the Preliminary 2016 Plan. A non-profit trade association, along with a municipal entity, suggested EPA investigate Hospitals (40 CFR Part 460), Concentrated Animal Feeding Operations (CAFO) (40 CFR Part 412), and Concentrated Aquatic Animal Production/Aquaculture (40 CFR Part 451), and expand these categories to include pretreatment standards for high-risk pathogens and pharmaceuticals. The organization representing POTWs opposed EPA's decision in the 2015 Annual Review Report that no further review of the Landfills (40 CFR Part 445) Category was warranted. The organization indicated that landfill leachate, which quenches ultraviolet (UV) light during UV disinfection, has been a source of interference at POTWs. The organization representing POTWs urged EPA to study the Landfills Category further to decide if pretreatment standards for landfill leachate are warranted. The organization representing POTWs also recommended that EPA further review the Soap and Detergent Manufacturing (40 CFR Part 417) Category to reevaluate the need for pretreatment standards. The standards are over 40 years old and the organization indicated that their POTW members are able to handle higher loads from this category than are currently allowed.

Table 3-1. Comments on the Preliminary 2016 Effluent Guidelines Program Plan
EPA Docket Number: EPA-HQ-OW-2015-0665

No.	Commenter Name	Commenter Organization (Type of Commenter)	EPA Docket No.	Comment Summary
1	David L. Smiga	United States Steel Corporation (U.S. Steel) (industry organization)	0305	Urge EPA to accept comments throughout the review process or extend the comment period to at least 120 days. Suggest that the current ELGs for Iron and Steel Manufacturing (40 CFR Part 420) are adequate and further regulating lead, nitrate, manganese/manganese compounds, and copper/copper compounds or adding new substances to the ELGs is not warranted. Indicate that data for discharges of PCBs, cyanide, and fluoride are not representative of all discharges within the category and should not have categorical limits.
2	Nichole Saunders	Environmental Defense Fund (EDF), (environmental organization)	0306	Strongly support EPA's ongoing research regarding discharge of conventional and unconventional oil and gas wastewater through CWT facilities. Provide comments and information related to accuracy and completeness of the CWT facility list, the Center for Sustainable Shale Development Discharge Standard, and produced water volumes and discharge practices. Urge EPA to complete the CWT study and move forward quickly with drafting necessary changes to the ELGs. Provide information on wastewater volumes and pollutants and concentrations in wastewater from conventional oil and gas extraction. Support efforts to understand chemicals present in produced water. Encourage EPA to expeditiously finalize its rule covering unconventional oil and gas extraction and immediately proceed to develop an accompanying rule for conventional oil and gas extraction.
3	V. Bruce Thompson	American Exploration & Production Council (AXPC) (industry organization)	0307	Indicate that the CWT memorandum is old and does not provide sufficient information to public commenters in regard to EPA's CWT study. Urge EPA to refine its list of facilities and only include facilities that meet the 40 CFR Part 437 definition of a CWT. Further, urge EPA to only focus on the facilities themselves (and owners of those facilities) and not on the generators of the oil and gas wastes accepted by such CWT facilities. Recommend that EPA consider the study within the context of the newly revised ELGs for the Oil and Gas Extraction Category, recognizing the importance of CWT facilities to the oil and gas industry along with the necessary benefits they provide, as they are one of the few remaining options for wastewater disposal.

Table 3-1. Comments on the Preliminary 2016 Effluent Guidelines Program Plan
EPA Docket Number: EPA-HQ-OW-2015-0665

No.	Commenter Name	Commenter Organization (Type of Commenter)	EPA Docket No.	Comment Summary
4	Claudio H. Ternieden	Water Environment Federation (WEF) (non-profit trade association)	0308	Suggest EPA address dilution in the definition of Initial and Period Certification Statements in 40 CFR Part 437.41 in the content of a CWTs submittal to a POTW. Suggest EPA reevaluate the scope and applicability of the CWT ELGs to industries currently covered under 40 CFR Part 437 to provide an opportunity to expand the regulation to all waste types processed by a CWT operation. Urge EPA to expand data acquisition and analysis to enable development of effluent limits to be developed potentially for non-limited pollutants of concern that would otherwise not undergo treatment. For the Metal Finishing Category (40 CFR Part 433), recommend EPA establish pretreatment standards for 1,4-dioxane and N-Nitrosodimethylamine (NDMA). Suggest developing pretreatment standards for high-risk pathogens and pharmaceuticals under the Hospital (40 CFR Part 460), Concentrated Animal Feeding Operations (CAFO) (40 CFR Part 412), and Aquaculture (40 CFR Part 451) point source categories.
5	Cynthia A. Finley	National Association of Clean Water Agencies (NACWA) (organization representing POTWs)	0309	Recommend EPA expand the scope of the CWT study to include all CWT facilities and incorporate additional standards to prevent pass-through and interference with wastes that are subsequently sent to POTWs. Urge EPA to further study the Landfills Category (40 CFR Part 445), citing that some POTWs have experienced interference with UV disinfection of landfill leachate. Since more POTWs are moving to UV disinfection, this issue should be analyzed to decide if national pretreatment standards for landfill leachate are necessary. Recommend that EPA further study the Soap and Detergent Manufacturing Category (40 CFR Part 417) to decide if pretreatment standards developed for this category over 40 years ago are still needed. Several individual NACWA members have also raised concerns regarding the Hospital Category (40 CFR Part 460) and Pharmaceutical Manufacturing Category (40 CFR Part 439).

Table 3-1. Comments on the Preliminary 2016 Effluent Guidelines Program Plan
EPA Docket Number: EPA-HQ-OW-2015-0665

No.	Commenter Name	Commenter Organization (Type of Commenter)	EPA Docket No.	Comment Summary
6	Amy Emmert	American Petroleum Institute (API) (industry organization)	0310	Urge EPA to discontinue the study of the Petroleum Refining ELGs unless it can provide clear, data-supported justification. If EPA proceeds with the study, recommended engaging American Petroleum Institute (API), American Petrochemical Manufacturers Association (AFPM) and their member companies as the principally affected stakeholders. Raised several issues related to the final ELGs for unconventional oil and gas extraction wastewater study. Suggest EPA abandon the distinction between unconventional and conventional wells and further that EPA withdraw the ELGs because they should have known the definition would be problematic. Urge EPA to be more forthcoming about information related to the CWT study and to provide more opportunity for public comment. Suggest that EPA limit the CWT study to those facilities defined as CWTs under 40 CFR Part 437. When evaluating oil and gas wastewater, urge EPA to consider the benefits of CWTs. Indicate that EPA's request for information related to conventional oil and gas extraction was overly broad and requested during an insufficient comment period. Encourage EPA to reach out to the oil and natural gas industry with specific questions as they arise.
7	Jennifer Richmond	Metropolitan Sewer District of Greater Cincinnati Industrial Waste Section (District) (municipal entity)	0311	Support EPA's ongoing study of new sources related to Metal Finishing (40 CFR Part 433). Request EPA expand its definitions of the Metal Finishing (40 CFR Part 433) terminologies such as phosphate conversion coating, passivation, and brush plating, and define new sources, such as wet air pollution controls, new operations in metal finishing, and treatment and recycling technologies for wastewater to facilitate classification of new and existing sources. Support EPA's continued study of wastewater generated from the manufacturing of sapphire crystals and its applicability under the Electrical and Electronic Components Category (40 CFR Part 469).

Table 3-1. Comments on the Preliminary 2016 Effluent Guidelines Program Plan
EPA Docket Number: EPA-HQ-OW-2015-0665

No.	Commenter Name	Commenter Organization (Type of Commenter)	EPA Docket No.	Comment Summary
8	Jim Colston	Orange County Sanitation District (Sanitation District) (municipal entity)	0312	Suggest EPA address dilution in the definition of Initial and Period Certification Statements in 40 CFR Part 437.41 in the content of a CWTs submittal to a POTW. Suggest EPA reevaluate the scope and applicability of the CWT ELGs to industries currently covered under 40 CFR Part 437 to provide an opportunity to expand the regulation to all waste types processed by a CWT operation. Urge EPA to expand data acquisition and analysis to enable development of effluent limits to be developed potentially for non-limited pollutants of concern that would otherwise not undergo treatment. For the Metal Finishing Category (40 CFR Part 433), recommend EPA establish pretreatment standards for 1,4-dioxane and NDMA. Suggest developing pretreatment standards for high-risk pathogens and pharmaceuticals under the Hospital (40 CFR Part 460), CAFOs (40 CFR Part 412), and Aquaculture (40 CFR Part 451) point source categories.
9	Wayne J. D'Angelo	Kelley Drye & Warren, LLP (on behalf of American Iron and Steel Institute [AISI], Steel Manufacturers Association [SMA], and Specialty Steel Industry of North America [SSINA]) (industry organizations)	0313	Urge EPA to accept comments throughout the review process or extend the comment period to at least 120 days. Offered assistance in collecting and better understanding the discharge characteristics and treatment of options available to the iron and steel industry. Generally, indicate that the ELGs for the Iron and Steel Manufacturing Category are adequate and do not require revision. Support EPA's results that the discharges of PCBs, cyanide, and fluoride reported on DMRs are not representative of the overall Iron and Steel Manufacturing Category. Indicate that regulation of nitrates, manganese/manganese compounds, and copper/copper compounds is also unwarranted as the number of facilities reporting releases to TRI is the sole basis for EPA's decision to further review these pollutants and TRI data historically over-estimates the actual releases. Indicate that lead is already regulated and EPA identified the TWPE as relatively low.
10	Jerry Schwartz	American Forest & Paper Association (AF&PA) (industry organization)	0314	Appreciate EPAs efforts to resolve any questions or outstanding data needs for review of the Pulp, Paper, and Paperboard Category (40 CFR Part 430) through coordination with the industry.

Table 3-1. Comments on the Preliminary 2016 Effluent Guidelines Program Plan
EPA Docket Number: EPA-HQ-OW-2015-0665

No.	Commenter Name	Commenter Organization (Type of Commenter)	EPA Docket No.	Comment Summary
11	John Noël, Adam Kron, Dusty Horwitt, Nathan Matthews, Tracy Carluccio, Amy Mall, Ron Slabe, Bruce Baizel	Clean Water Action, Environmental Integrity Project, Partnership for Policy Integrity, Sierra Club, Delaware Riverkeeper Network, Natural Resources Defense Council, Upper Burrell Citizens Against Marcellus Pollution, Earthworks (environmental organizations)	0315	Support and recommend that EPA expedite its study and revision of the CWT ELGs (40 CFR Part 437) due to the potential increase in oil and gas wastewater sent to CWTs as a result of the recently revised ELGs related to unconventional oil and gas extraction. Suggest the CWT ELGs are out of date and offer inadequate protection for modern oil and gas extraction practices and the dramatic increase in produced water. Support EPA's decision to collect data and information on wastewater originating from conventional oil and gas extraction and known transfers to POTWs. Suggest new data sources for wastewater volume information in PA, WV, and CO Indicate that conventional oil and gas wastewater contains many of the same constituents as unconventional oil and gas wastewater, including those that make transfer to POTWs infeasible and dangerous. Support EPA's decision to collect data on produced water discharges from the oil and gas industry as it relates to 40 CFR Part 435, Subpart E, and suggested expansion of the scope of quantity, composition, and purpose research beyond the narrow subset of fluids labeled as "well treatment fluids" and "workover fluids." Recommend EPA expedite a parallel ELG update for coalbed methane extraction considering any inevitable shifts in gas prices, demand, and costs of wastewater treatment.

4. EPA'S CONTINUED PRELIMINARY REVIEW OF CATEGORIES IDENTIFIED FROM THE 2015 TOXICITY RANKING ANALYSIS

As part of its 2015 Annual Review, EPA conducted a toxicity ranking analysis (TRA) to identify, rank, and prioritize for further review, based on toxic-weighted pound equivalents (TWPE), point source categories with pollutant discharges that may pose a hazard to human health and the environment. See Section 2 of *The 2015 Annual Effluent Guidelines Review Report* (2015 Annual Review Report) for details on the TRA methodology (EPA-HQ-OW-2015-0665-0299). From the 2015 TRA and initial preliminary category reviews, EPA identified three point source categories for further review: Iron and Steel Manufacturing (40 CFR Part 420); Organic Chemicals, Plastics, and Synthetic Fibers (OCPSF) (40 CFR Part 414); and Pulp, Paper, and Paperboard (Pulp and Paper) (40 CFR Part 430) (EPA-HQ-OW-2015-0665-0290).

EPA continued its preliminary reviews of these three point source categories, focusing on the discharge and treatment of a subset of pollutants that contributed to a majority of each category's respective TWPE (i.e., pollutants of interest).

EPA documented the usability and quality of the data supporting its continued preliminary reviews of these point source categories and analyzed how the data could be used to improve the characterization of industrial wastewater discharges (e.g., the universe of facilities with known or potential discharges, concentration and quantity of pollutants, availability and performance of advances in wastewater treatment). See Appendix A of this report for more information on data usability and quality of the data sources supporting these reviews.

As a part of its review of these three point source categories, EPA also evaluated available data in the Canadian National Pollutant Release Inventory (NPRI) to identify additional pollutants that may potentially be present in industrial wastewater discharge in the U.S., as indicated by their presence in industrial wastewater discharges in Canada. Canada's NPRI is an analogous program to the Toxics Release Inventory (TRI) in the U.S. For more information on the general methodology, data sources, and limitations associated with EPA's analysis of the NPRI data, see Section 2.2 above.

Sections 4.1 through 4.3 of this report detail the methodology and evaluations from EPA's continued preliminary review of the Iron and Steel Manufacturing, OCPSF, and Pulp and Paper point source categories, respectively, including the category-specific evaluations from the NPRI analysis.

4.1 Iron and Steel Manufacturing (40 CFR Part 420)

As part of the 2015 Annual Review, EPA initiated a preliminary category review of the Iron and Steel Manufacturing Category because it ranked high, in terms of toxic-weighted pound equivalents (TWPE), in the final 2015 toxicity rankings analysis (TRA) (U.S. EPA, 2016a). EPA previously reviewed discharges from this category as part of the 2011 and 2013 Annual Reviews (U.S. EPA, 2012, 2014a).

From its 2015 TRA and preliminary category reviews, EPA decided that the Iron and Steel Manufacturing Category warrants further review, specifically related to the discharges of lead and lead compounds (lead), nitrate compounds (nitrate), and copper and copper compounds (copper), and manganese and manganese compounds (manganese) (U.S. EPA, 2016b). Of these pollutants, the Iron and Steel Manufacturing Category effluent limitations guidelines and standards (ELGs) establish limitations for only lead. As part of this review, EPA further evaluated the discharges of these pollutants to:

- Understand the process operations at iron and steel manufacturing facilities that generate the pollutants and how the facilities are currently managing their wastewater.
- Understand how permitting authorities currently regulate discharges of the pollutants.
- Decide if the concentrations of lead, nitrate, copper, or manganese in effluent discharges are present at levels that could be reduced by further treatment.
- Identify advances in industrial wastewater treatment technology performance for reducing discharges of the pollutants.
- Identify additional pollutants potentially present in facility industrial wastewater discharges in the U.S., not currently captured in discharge monitoring report (DMR) data or Toxics Release Inventory (TRI) data.

Section 4.1.1 provides a background of the Iron and Steel Manufacturing Category (40 CFR Part 420), and Section 4.1.2 provides a summary of the results of the previous ELG planning review related to the Iron and Steel Manufacturing Category. Sections 4.1.3 through 4.1.5 present EPA's current review approach and evaluation of the Iron and Steel Manufacturing Category, including results from EPA's continued review of the top pollutants in the category, evaluation of available treatment technology performance, and the results of the additional pollutant analysis. Section 4.1.6 summarizes EPA's current review of the Iron and Steel Manufacturing Category.

4.1.1 Iron and Steel Manufacturing Category Background

EPA first promulgated ELGs for the Iron and Steel Manufacturing Category (40 CFR Part 420) in 1974 (39 FR 24114) and made the last significant amendment to the rule in October 2002 (67 FR 64216). The Iron and Steel Manufacturing ELGs cover facilities that produce raw materials used in ironmaking and steelmaking or produce finished or semi-finished steel products (U.S. EPA, 2002). The Iron and Steel Manufacturing ELGs include 13 subcategories, listed in Table 4-1. Table 4-1 also includes the corresponding applicability and pollutants with limitations for each subcategory.

For the purpose of its ELG planning reviews, EPA generally considers facilities classified under the following seven North American Industry Classification System (NAICS) codes and four Standard Industrial Classification (SIC) codes to be part of the Iron and Steel Manufacturing Category, as identified from the NAICS-Point Source Category (PSC) and SIC-PSC crosswalks developed for the 304m review process (U.S. EPA, 2009):

- NAICS 331111: Iron and Steel Mills (including Cokemaking Facilities)
- NAICS 331210 (SIC 3317): Iron and Steel Pipe and Tube Manufacturing
- NAICS 331221 (SIC 3312): Rolled Steel Shape Manufacturing (Blast Furnace, Steel Works, and Rolling Mills)

- NAICS 331222 (SIC 3315): Steel Wire Drawing and Steel Nails
- Steelmaking facilities within the following NAICS codes:
  - NAICS 332618: Other Fabricated Wire Product Manufacturing
  - NAICS 332112: Nonferrous Forging (Blast Furnace, Steel Works, and Rolling Mills)
  - NAICS 332813 (SIC 3316): Electroplating, Plating, Polishing, Anodizing, and Coloring (Cold Rolled Steel) NAICS codes

Based on data in the 2002 *Development Document for Final Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category* (Iron and Steel Manufacturing Development Document), EPA estimated that there were 254 facilities with iron and steel manufacturing wastewater discharges in the Iron and Steel Manufacturing Category, with 133 facilities reporting direct releases to surface waters, 70 facilities reporting releases to publicly owned treatment works (POTWs), and 56 facilities reporting zero discharges (U.S. EPA, 2002).[14,15]

EPA identified 221 iron and steel manufacturing facilities reporting water releases to TRI in 2014, with 116 facilities reporting direct releases to surface waters, 52 facilities reporting indirect releases to POTWs, and 53 facilities reporting both direct and indirect releases (*TRILTOutput2014_v1*). EPA identified 70 iron and steel manufacturing facilities that submitted 2014 DMR data to the Integrated Compliance Information System for the National Pollutant Discharge Elimination System (ICIS-NPDES) (*DMRLTOutput2014_v1*). While these numbers appear to show a slight decline in the number of iron and steel manufacturing facilities discharging since the early 2000s, due to the limitations of the DMR and TRI datasets, EPA does not have an exact count of how many facilities currently are subject to the Iron and Steel Manufacturing ELGs. See Section 2.1 for a discussion on the limitations of DMR and TRI data.

[14] The total number of facilities (254) does not equal the sum of direct (133), indirect (70), and zero discharging (56) facilities due to instances where two sites are counted as one integrated facility (U.S. EPA, 2002).

[15] Zero dischargers are sites that do not discharge process wastewater and sites that are completely dry (i.e., do not use water in iron and steel operations) (U.S. EPA, 2002).

Table 4-1. ELG Applicability and Pollutants with Limitations for the Iron and Steel Manufacturing Category (40 CFR Part 420)

Subpart	Subcategory Title	Basis for ELG Applicability	Pollutants with Limitations														
			Ammonia as N	Benzo(a)pyrene	Chromium	Cyanide	Lead	Naphthalene	Nickel	Oil and Grease	pH	Phenols (4AAP)	Tetrachloro-ethylene	Total Residual Chlorine	Total Suspended Solids	Zinc	2, 3, 7, 8- TCDF
A	Cokemaking	Discharges to waters of the U.S. and the introduction of pollutants into a POTW from byproduct and other cokemaking operations.	X	X		X		X		X	X	X			X		
B	Sintering	Discharges to waters of the U.S. and the introduction of pollutants into a POTW from sintering operations conducted by heating iron-bearing wastes together with fine iron ore, limestone, and coke fines in an ignition furnace to produce an agglomerate for charging to the blast furnace.	X							X	X	X		X	X	X	X
C	Ironmaking	Discharges to waters of the U.S. and the introduction of pollutants into a POTW from ironmaking operations in which iron ore is reduced to molten iron in a blast furnace.	X			X	X			X	X	X		X	X	X	
D	Steelmaking	Discharges to waters of the U.S. and the introduction of pollutants into a POTW from steelmaking operations conducted in basic oxygen and electric arc furnaces.					X				X				X	X	
E	Vacuum Degassing	Discharges to waters of the U.S. and the introduction of pollutants into a POTW from vacuum degassing operations conducted by applying a vacuum to molten steel.					X				X				X	X	
F	Continuous Casting	Discharges to waters of the U.S. and the introduction of pollutants into a POTW from continuous casting of molten steel into intermediate or semi-finished steel products through water cooled molds.					X			X	X				X	X	

Table 4-1. ELG Applicability and Pollutants with Limitations for the Iron and Steel Manufacturing Category (40 CFR Part 420)

			Pollutants with Limitations														
Subpart	**Subcategory Title**	**Basis for ELG Applicability**	**Ammonia as N**	**Benzo(a)pyrene**	**Chromium**	**Cyanide**	**Lead**	**Naphthalene**	**Nickel**	**Oil and Grease**	**pH**	**Phenols (4AAP)**	**Tetrachloro-ethylene**	**Total Residual Chlorine**	**Total Suspended Solids**	**Zinc**	**2, 3, 7, 8- TCDF**
G	Hot Forming	Discharges to waters of the U.S. and the introduction of pollutants into a POTW from hot forming operations conducted in primary, section, flat, and pipe and tube mills.								X	X				X		
H	Salt Bath Descaling	Discharges to waters of the U.S. and the introduction of pollutants into a POTW from oxidizing and reducing salt bath descaling operations.			X	X			X		X				X		
I	Acid Pickling	Discharges to waters of the U.S. and the introduction of pollutants into a POTW from sulfuric acid, hydrochloric acid, or combination acid pickling operations.			X		X		X	X	X				X	X	
J	Cold Forming	Discharges to waters of the U.S. and the introduction of pollutants into a POTW from cold rolling and cold working pipe and tube operations in which unheated steel is passed through rolls or otherwise processed.			X		X	X	X	X	X		X		X	X	
K	Alkaline Cleaning	Discharges to waters of the U.S. and the introduction of pollutants into a POTW from operations in which steel and steel products are immersed in alkaline cleaning baths to remove mineral and animal fats or oils from the steel, and those rinsing operations which follow immersion.								X	X				X		
L	Hot Coating	Discharges to waters of the U.S. and the introduction of pollutants into a POTW from operations in which steel is coated with zinc, terne metal, or other metals by the hot dip process, and associated rinsing operations.			X		X			X	X				X	X	

Table 4-1. ELG Applicability and Pollutants with Limitations for the Iron and Steel Manufacturing Category (40 CFR Part 420)

			Pollutants with Limitations														
Subpart	Subcategory Title	Basis for ELG Applicability	Ammonia as N	Benzo(a)pyrene	Chromium	Cyanide	Lead	Naphthalene	Nickel	Oil and Grease	pH	Phenols (4AAP)	Tetrachloro-ethylene	Total Residual Chlorine	Total Suspended Solids	Zinc	2, 3, 7, 8- TCDF
M	Other Operations	Discharges to waters of the U.S. and the introduction of pollutants into a POTW from production of direct-reduced iron and from briquetting and forging operations.								X	X				X		

Source: 40 CFR Part 420

4.1.2 Summary of the Results of the 2015 Annual Review for the Iron and Steel Manufacturing Category

During the 2015 Annual Review, EPA identified discharges of lead, nitrate, manganese, and copper for further review. The paragraphs below summarize the results of EPA's previous review regarding these four pollutants (U.S. EPA, 2016b).

- *Lead.* One facility accounted for 19 percent of the TRI lead releases in 2013, with a TWPE of 4,360. The facility identified a data error in the indirect releases reported to TRI; correcting this error decreased the facility's lead TWPE to 1,100. After this correction, no individual facility in the 2013 DMR and TRI data discharged more than 2,300 TWPE of lead. However, due to the number of facilities reporting releases of lead to TRI and in DMRs in 2013 (133 facilities in TRI and 33 in DMRs), EPA concluded that further investigation of lead was appropriate to evaluate whether the Iron and Steel Manufacturing ELGs adequately control lead discharges.
- *Nitrate, copper, and manganese.* EPA also identified a number of facilities that reported releases of nitrate, copper, and manganese to TRI in 2013 (56, 114, and 79 facilities reported releases of nitrate, copper, and manganese, respectively). Because the Iron and Steel Manufacturing ELGs do not include limitations for these pollutants, EPA concluded that further investigations of nitrate, copper, and manganese were appropriate to evaluate whether control technologies are available to further reduce discharges.

4.1.3 Introduction to EPA's Current Evaluation of Specific Pollutants in the Iron and Steel Manufacturing Category

For the current review, EPA evaluated the discharges of lead, nitrate, copper, and manganese to satisfy the objectives outlined above in Section 4.1. Specifically, EPA:

- Evaluated available 2014 DMR and TRI data[16] for the four pollutants, including concentration data reported on DMRs.
- Contacted several iron and steel manufacturing facilities reporting releases of the four pollutants to TRI to gather information on process operations contributing to those releases, wastewater treatment technologies, and discharged concentrations.
- Reviewed the results and compared current discharge concentrations to concentrations achievable by technologies considered during the 2002 Iron and Steel Manufacturing Category rulemaking.
- Contacted state permitting authorities to further understand the development of pollutant permit limits and current processes for managing wastewater containing these pollutants.
- Researched the performance of available treatment technologies in the Industrial Wastewater Treatment Technology (IWTT) Database for the four pollutants.

[16] EPA evaluated 2014 data because it represented the most current and complete DMR and TRI dataset available at the start of this review. Note that EPA evaluated 2013 DMR and TRI data in support of the previous review.

- Reviewed available data in Canada's National Pollutant Release Inventory (NPRI) to identify any additional pollutants that may be present in iron and steel manufacturing wastewater discharges that are not reported in the U.S. under the TRI or DMR programs.

Table 4-2 compares the 2013 and 2014 TRI and DMR TWPE and the number of facilities reporting discharges of the four pollutants. Section 4.1.4 presents EPA's analyses and results related to lead, nitrate, copper, and manganese. Section 4.1.5 presents EPA's analysis of the NPRI data.

Table 4-2. 2013 and 2014 DMR and TRI TWPE and Number of Iron and Steel Manufacturing Facilities Discharging Lead, Manganese, Nitrate, and Copper

Pollutant	2014 TRI Data		2013 TRI Data		2014 DMR Data		2013 DMR Data	
	Number of Facilities [a]	TWPE	Number of Facilities [a]	TWPE	Number of Facilities [a]	TWPE	Number of Facilities [a]	TWPE
Lead	136	15,400	133	20,600	36	4,190	37	8,760
Manganese	115	13,000	114	5,680	8	2,140	8	1,760
Nitrate	57	27,700	56	25,400	3	329	3	502
Copper	84	5,020	79	4,990	30	2,650	34	3,760
Total for All Pollutants Reported	**221**	**85,900[b]**	**215**	**82,600[c]**	**70**	**116,000[b]**	**80**	**182,000[c]**

Sources: *TRILTOutput2014_v1*; *TRILTOutput2013_v1*; *DMRLTOutput2014_v1*; *DMRLTOutput2013_v1*.
Note: Sums of individual values may not equal the total presented, due to rounding.
[a] Number of iron and steel manufacturing facilities with TWPE greater than zero.
[b] EPA did not complete a comprehensive quality review of the remainder of the 2014 TRI and DMR data; therefore, this total may include outliers. See Section 2.1 for more information.
[c] Total includes corrected data as identified during the 2015 Annual Review (U.S. EPA, 2016a).

4.1.4 Iron and Steel Manufacturing Category Review of Lead, Nitrate, Copper, and Manganese

During the 2002 rulemaking, EPA collected information about the concentrations of lead, nitrate, copper, and manganese in iron and steel manufacturing discharges, and calculated, for certain subcategories, long-term averages (LTAs) reflecting various technology bases. These LTAs are the average performance level that a facility with well-designed and operated model pollution removal technologies is capable of achieving for the subcategory based on the data collected during the 2002 rulemaking.

For reasons cited in the Iron and Steel Manufacturing Development Document and 2002 final rule, and described briefly in the subsections below, EPA did not revise the ELGs for lead using the subcategorization scheme from the proposed rule and did not establish limitations for nitrate, copper, or manganese (see 67 FR 64216 and (U.S. EPA, 2002)). However, for the purpose of this preliminary category review, the LTAs developed as part of the proposed rule provide an indication of the performance of available technologies evaluated at the time of the rulemaking and serve as a useful basis for comparison and understanding of current lead, nitrate, copper, and manganese discharges. EPA notes that for many of the proposed subcategories, wastewater flow reduction steps, in concert with better performance of blowdown treatment systems, provided the primary basis for the proposed limitations and standards (67 FR 64216).

For this review, EPA obtained current direct and indirect discharge concentrations of lead, nitrate, copper, and manganese from iron and steel manufacturing facilities following the methodology outlined in Section 2.1.4. Specifically, EPA compiled average concentration data for nitrate, copper, and manganese reported on DMRs. Additionally, EPA identified and contacted 16 facilities to understand reported releases to TRI and gather underlying concentration data that formed the basis for the TRI-reported direct and indirect releases of lead, nitrate, copper, and manganese (compiled in ERG, 2016 and summarized below). EPA compared these concentration data to the LTAs achieved by technologies evaluated during the 2002 Iron and Steel Manufacturing rulemaking to provide a frame of reference for the magnitude of the discharges and to identify potential changes to discharges since 2002. For this analysis, EPA did not attempt to subcategorize the facility concentration data for a more specific comparison to the relevant LTAs. EPA compared the concentrations to the range of LTAs identified during the 2002 rulemaking across the subcategories.

Table 4-3 lists the facilities EPA contacted, along with information they provided regarding their process operations and treatment technologies. Nine facilities reported direct releases and seven reported indirect releases of one or more of the pollutants reviewed. Of these 16 facilities, EPA did not obtain concentration data from one direct discharger (IPSCO Tubulars Inc., Wilder, Kentucky) and three indirect dischargers (ADCOM Wire Co., Jacksonville, Florida; O&K American Corporation, Chicago, Illinois; and Jewel Acquisition LLC, Louisville, Ohio). EPA presents its analysis of the DMR and TRI-based concentration data for lead, nitrate, copper, and manganese in Sections 4.1.4.1 through 4.1.4.4, respectively.

To further understand discharges and treatment of lead, nitrate, copper, and manganese, EPA contacted two states, Indiana and West Virginia, that have a high proportion of iron and steel manufacturing facilities with reported lead, nitrate, copper, and/or manganese discharges. EPA also evaluated available treatment technology pollutant removal data. Sections 4.1.4.5 and 4.1.4.6 present the results of these analyses.

Table 4-3. Facilities Contacted to Obtain Underlying Concentration Data for Pollutant Releases Reported to TRI in 2014

Facility Name	Facility Location	Facility-Provided Process and Treatment Technology Information[a]	Direct or Indirect Releases	Pollutant(s)	Concentration Data Provided[b]	Reference
AK Steel Corp – Coshocton Works	Coshocton, OH	Nitrate discharges result from pickling of stainless steel, a process that uses a large amount of nitric acid.	Direct	Nitrate, Manganese	Yes	(Montag, 2016)
Arcelormittal Burns Harbor LLC	Burns Harbor, IN	No process or treatment technology information provided.	Direct	Lead	Yes	(Bley, 2016)
Arcelormittal Wierton LLC	Weirton, WV	Lead releases result from the tin plating process. Facility does not have treatment technologies installed to target the removal of lead. Copper and manganese are byproducts of the tin plating process and marked as an impurity.	Direct	Lead, Copper, Manganese	Yes	(Mieczkowski, 2016)
IPSCO Tubulars, Inc.	Wilder, KY	Facility contact did not respond.	Direct	Lead, Manganese	No	(Clifton, 2016)
NLMK Pennsylvania Corp	Farrell, PA	The facility is a steel mill and certain grades of steel that they roll can contain manganese. A small portion of the manganese generated is discharged in the wastewater, while the majority of it ends up in the sludge. Another source of manganese is the steel slabs that the facility purchases. The facility currently has clarifiers for settling, but no specific treatment technologies in place for manganese.	Direct	Manganese	Yes	(Herman, 2016)
USS Gary Works	Gary, IN	Releases result from sinter, iron and steel production, coke production, and rolling and finishing operations.	Direct	Lead, Nitrate, Copper, Manganese	Yes	(Lasko, 2016)
USS Mon Valley Works – Edgar Thompson Plant	Braddock, PA	Releases result from steel production, specifically from the caster.	Direct	Lead, Nitrate, Copper, Manganese	Yes	(Lasko, 2016)
USS Mon Valley Works – Irvin Plant	West Mifflin, PA	Releases result from hot rolling and finishing operations.	Direct	Lead, Nitrate, Manganese	Yes	(Lasko, 2016)
US Steel Corp – Fairfield Works	Fairfield, AL	Releases result from iron production and steel finishing.	Direct	Lead, Copper, Manganese	Yes	(Lasko, 2016)
ADCOM Wire Co.	Jacksonville, FL	The facility manufactures wire. Lead is found in the wastewater from the lead-wire base.	Indirect	Lead	No	(Killian, 2016)

Table 4-3. Facilities Contacted to Obtain Underlying Concentration Data for Pollutant Releases Reported to TRI in 2014

Facility Name	Facility Location	Facility-Provided Process and Treatment Technology Information[a]	Direct or Indirect Releases	Pollutant(s)	Concentration Data Provided[b]	Reference
Carpenter Technology Corp.	Reading, PA	Copper is introduced to the wastewater from plating and stripping operations. The facility performs chemical precipitation in order to treat the wastewater on-site before sending the discharges to the POTW.	Indirect	Copper	Yes	(McGowan, 2016)
DW–National Standard – Stillwater LLC	Stillwater, OK	Lead and copper releases result from raw materials used in carbon steel wire production.	Indirect	Lead, Copper	Yes	(Banks, 2016)
Jewel Acquisition LLC	Louisville, OH	The facility performs pickling operations with nitric acid that may result in discharges of lead, nitrate, copper, and manganese. The facility uses neutralization combined with settling for pretreatment before discharging wastewater to the POTW.	Indirect	Lead, Nitrate, Copper, Manganese	No	(Calderazzo, 2016)
O&K American Corporation	Chicago, IL	Lead and manganese releases result from steel wire production using an acid pickling operation. The facility has a conventional precipitation wastewater treatment system.	Indirect	Lead, Manganese	No	(Welsh, 2016)
SWVA, Inc.	Huntington, WV	Lead releases result from melting steel. Lead is not added but enters the wastewater from the melting of raw materials.	Indirect	Lead	Yes	(Artrip, 2016)
Valbruna Slater Stainless Steel	Fort Wayne, IN	Releases result from hot rolling and cold finishing operations.	Indirect	Copper, Manganese	Yes	(Hacker, 2016)

[a] This table reflects only the information provided by facility contacts.
[b] EPA compiled the concentration data provided by the facilities into a spreadsheet to support the analyses discussed in this section (ERG, 2016).

4.1.4.1 Evaluation of Lead Discharge Concentrations

During the 2002 Iron and Steel Manufacturing rulemaking, EPA evaluated discharges and calculated LTAs for lead reflecting technology bases for the proposed subcategories considered during the development of the rulemaking (see 65 FR 81963). Table 4-4 lists the technology bases and lead LTAs extracted from the Iron and Steel Manufacturing Development Document (U.S. EPA, 2002).

Table 4-4. 2002 Iron and Steel Manufacturing Rule Technology Bases and LTA Lead Values by Subcategory

Subcategory (Segment)	Option	Technology Basis	LTA for Lead (µg/L)
Non-Integrated Steelmaking and Hot Forming (Carbon and Alloy)	BAT	High-rate recycle systems and associated treatment for solids removal (scale pits, clarification, filtration), and water cooling prior to reuse. Multimedia (mixed media) filtration removes solids not removed by scale pits and clarification.	6.43
Finishing (Carbon and Alloy)	BAT	In-process technologies include flow reduction through countercurrent rinsing, recycle of fume scrubber water, and reuse of acid. End-of-pipe treatment includes oil removal, flow equalization, hexavalent chromium reduction (for certain waste streams), metals precipitation, gravity clarification, sludge dewatering.	7.54
Integrated Steel (Carbon and Alloy)	BAT	High-rate recycle using a scale pit with oil skimming, a roughing clarifier with oil skimming, sludge dewatering, a multimedia filter for polishing, and a cooling tower to lower the water temperature to acceptable levels to reuse and treatment of blowdown with multimedia filtration.	14.1
Integrated Steel (Stainless)	BAT	High-rate recycle using a scale pit with oil skimming, a roughing clarifier with oil skimming, sludge dewatering, a multimedia filter for polishing, and a cooling tower to lower the water temperature to acceptable levels to reuse and treatment of blowdown with multimedia filtration.	69.3

Source: (U.S. EPA, 2002)
BAT: Best Available Technology Economically Achievable

Evaluation of Direct Discharge Lead Concentrations

For this analysis, EPA obtained lead concentration data from 35 iron and steel manufacturing facilities: 28 from data reported on 2014 DMRs and seven from facilities reporting direct releases to TRI in 2014. Table 4-5 summarizes the average iron and steel manufacturing direct discharging facility 2014 DMR and TRI lead concentration data. EPA compared the range of facility concentrations shown in Table 4-5 to the lead LTAs from the 2002 rule listed in Table 4-4. The comparison shows that the median lead concentrations from DMR and TRI data are below the LTAs for all subcategories.

Table 4-5. Iron and Steel Manufacturing Facility 2014 Average Direct Discharge Lead Concentration Data

Data Type	Number of Data Points [a]	Average Lead Concentrations (µg/L)		
		Minimum	Median	Maximum
2014 Iron and Steel Facility DMR Data	59	0	2.50	114
2014 Iron and Steel Facility TRI Data	28	Non-detect	2.82	355

Source: *DMRLTConcOutput2014_v1*; (ERG, 2016)

[a] The number of data points represents the number of outfalls, not facilities. Some facilities have more than one outfall.

Evaluation of Indirect Discharge Lead Concentrations

For this analysis, EPA obtained lead concentration data from two iron and steel manufacturing facilities reporting indirect releases to TRI in 2014. Table 4-6 summarizes the average iron and steel manufacturing facility 2014 TRI lead concentration data being sent to POTWs. EPA compared these concentrations to the lead LTAs from the 2002 rule listed in Table 4-4. The comparison shows that SWVA Inc.'s average lead concentration is above the LTAs for all subcategories and DW – National Standard's average lead concentration is above the LTAs for all subcategories except the integrated steel subcategory, stainless segment. However, the concentrations listed in Table 4-6 represent concentrations from facilities reporting the highest indirect releases of lead to TRI.

Table 4-6. Iron and Steel Manufacturing Facility 2014 Average Indirect Discharge Lead Concentration Data

Facility Name and Location	Average Lead Concentration
SWVA, Inc., Huntington, WV	110 µg/L
DW – National Standard – Stillwater LLC, Stillwater, OK	59.8 µg/L

Source: (ERG, 2016)

4.1.4.2 Evaluation of Nitrate Discharge Concentrations

During the 2002 rulemaking, EPA evaluated discharges and calculated LTAs for nitrate reflecting technology bases for the proposed subcategories considered during the development of the rulemaking. Table 4-7 lists the technology bases and nitrate LTAs extracted from the Iron and Steel Manufacturing Development Document (U.S. EPA, 2002).

Table 4-7. 2002 Iron and Steel Manufacturing Rule Technology Bases and LTA Nitrate Values by Subcategory

Subcategory (Segment)	Option	Technology Basis	LTA for Nitrate (mg/L)
Finishing (Carbon and Alloy)	BAT	In-process technologies include flow reduction through countercurrent rinsing, recycle of fume scrubber water, and reuse of acid. End-of-pipe treatment includes oil removal, flow equalization, hexavalent chromium reduction (for certain waste streams), metals precipitation, gravity clarification, sludge dewatering.	0.114

Table 4-7. 2002 Iron and Steel Manufacturing Rule Technology Bases and LTA Nitrate Values by Subcategory

Subcategory (Segment)	Option	Technology Basis	LTA for Nitrate (mg/L)
Cokemaking (Byproduct Recovery)	PSES	Emission control scrubber blowdown to coke quench stations, oil and tar removal, flow equalization, free and fixed ammonia stripping, and post ammonia stripping equalization.	0.831
Integrated Steel (Stainless)	BAT	High-rate recycle using a scale pit with oil skimming, a roughing clarifier with oil skimming, sludge dewatering, a multimedia filter for polishing, and a cooling tower to lower the water temperature to acceptable levels to reuse and treatment of blowdown with multimedia filtration.	1.95
Cokemaking (Byproduct Recovery)	BAT	Emission control scrubber blowdown to coke quench stations, oil and tar removal, flow equalization, free and fixed ammonia distillation (stripping), indirect cooling, flow equalization, biological treatment and secondary clarification, sludge dewatering.	114

Source: (U.S. EPA, 2002)
BAT: Best Available Technology Economically Achievable
PSES: Pretreatment Standards for Existing Sources

Evaluation of Direct Discharge Nitrate Concentrations

For this analysis, EPA obtained nitrate concentration data from six iron and steel manufacturing facilities; two from data reported on 2014 DMRs and four from facilities reporting direct releases to TRI in 2014. Table 4-8 summarizes the average iron and steel manufacturing direct discharging facility 2014 DMR and TRI nitrate concentration data. EPA compared the range of facility concentrations shown in Table 4-8 to the nitrate LTAs from the 2002 rule listed in Table 4-7. EPA also contacted one facility that reported indirect releases of nitrate to TRI (Jewel Acquisition LLC, Louisville, Ohio), but was unable to obtain any data. This facility accounted for 56 percent of the 2014 TRI nitrate releases. Because EPA did not obtain any data on nitrate concentrations in indirect releases, the discussion below is limited to direct discharges.

The comparison to the LTAs (from Table 4-7) shows that the median nitrate concentrations in both data sets are above the finishing subcategory and cokemaking subcategory, PSES option LTAs, similar to the integrated steel subcategory LTA, and below the cokemaking subcategory, BAT option LTA. However, for this screening-level analysis, EPA did not identify and directly compare the individual facility discharges with the LTAs. EPA notes that the cokemaking subcategory, BAT option LTA, which includes biological treatment, is at least two orders of magnitude higher than the other subcategories (U.S. EPA, 2002).

Table 4-8. Iron and Steel Manufacturing Facility 2014 Average Direct Discharge Nitrate Concentration Data

Data Type	Number of Data Points [a]	Average Nitrate Concentrations (mg/L)		
		Minimum	Median	Maximum
2014 Iron and Steel Facility DMR Data	4	0.072	1.74	34.9
2014 Iron and Steel Facility TRI Data	12	0.221	1.44	35.9

Source: *DMRLTConcOutput2014_v1*; (ERG, 2016)

[a] The number of data points represents the number of outfalls, not facilities. Some facilities have more than one outfall.

4.1.4.3 Evaluation of Copper Discharge Concentrations

During the 2002 rulemaking, EPA evaluated discharges and calculated LTAs for copper reflecting technology bases for the proposed subcategories considered during the development of the rulemaking. For many subcategories considered, copper was either not detected or detected at low concentrations (U.S. EPA, 2002). Table 4-9 lists the technology bases and copper LTAs extracted from the Iron and Steel Manufacturing Development Document (U.S. EPA, 2002).

Table 4-9. 2002 Iron and Steel Manufacturing Rule Technology Bases and LTA Copper Values by Subcategory

Subcategory (Segment)	Option	Technology Basis	LTA for Copper (µg/L)
Integrated Steel (Stainless)	BAT	High-rate recycle using a scale pit with oil skimming, a roughing clarifier with oil skimming, sludge dewatering, a multimedia filter for polishing, and a cooling tower to lower the water temperature to acceptable levels to reuse and treatment of blowdown with multimedia filtration.	10.1
Finishing (Carbon and Alloy)	BAT	In-process technologies include flow reduction through countercurrent rinsing, recycle of fume scrubber water, and reuse of acid. End-of-pipe treatment includes oil removal, flow equalization, hexavalent chromium reduction (for certain waste streams), metals precipitation, gravity clarification, sludge dewatering.	21.0

Source: (U.S. EPA, 2002)
BAT: Best Available Technology Economically Achievable

Evaluation of Direct Discharge Copper Concentrations

For this analysis, EPA obtained copper concentration data from 28 iron and steel manufacturing facilities: 24 from data reported on 2014 DMRs and four from facilities reporting direct releases to TRI in 2014. Table 4-10 summarizes the average iron and steel manufacturing direct discharging facility 2014 DMR and TRI copper concentration data. EPA compared the range of facility concentrations shown in Table 4-10 to the copper LTAs from the 2002 rule listed in Table 4-9. The comparison shows that the median copper concentrations from DMR and TRI are similar to the integrated steel subcategory LTA and less than the finishing subcategory LTA. However, for this screening-level analysis EPA did not identify and directly compare the individual facility discharges with the LTAs.